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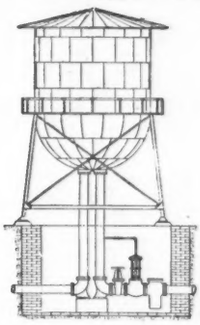

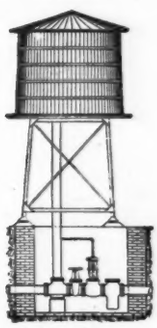

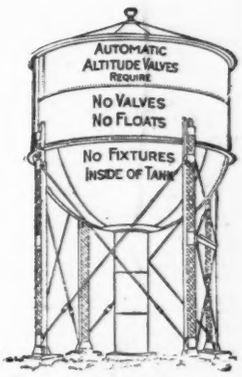

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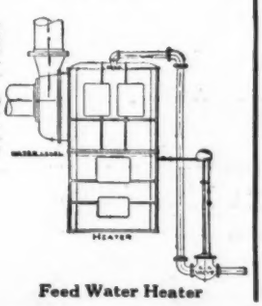

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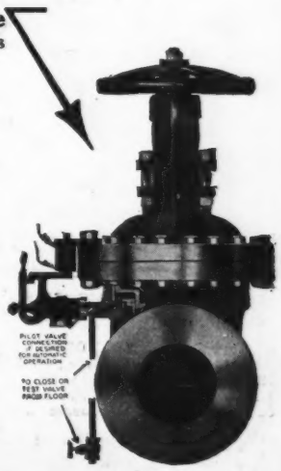

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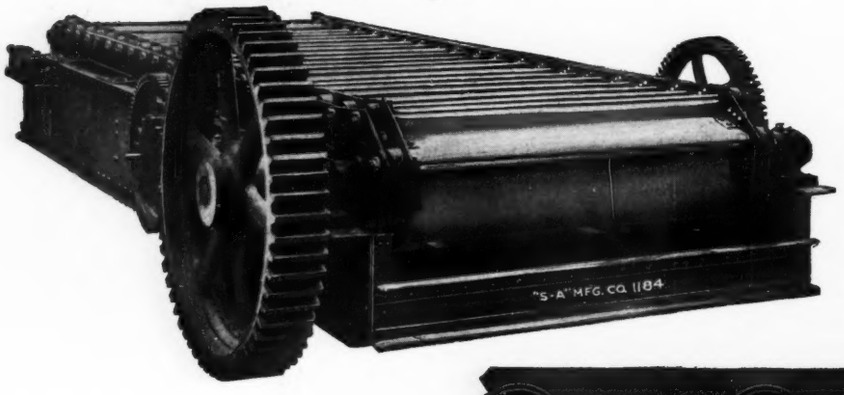

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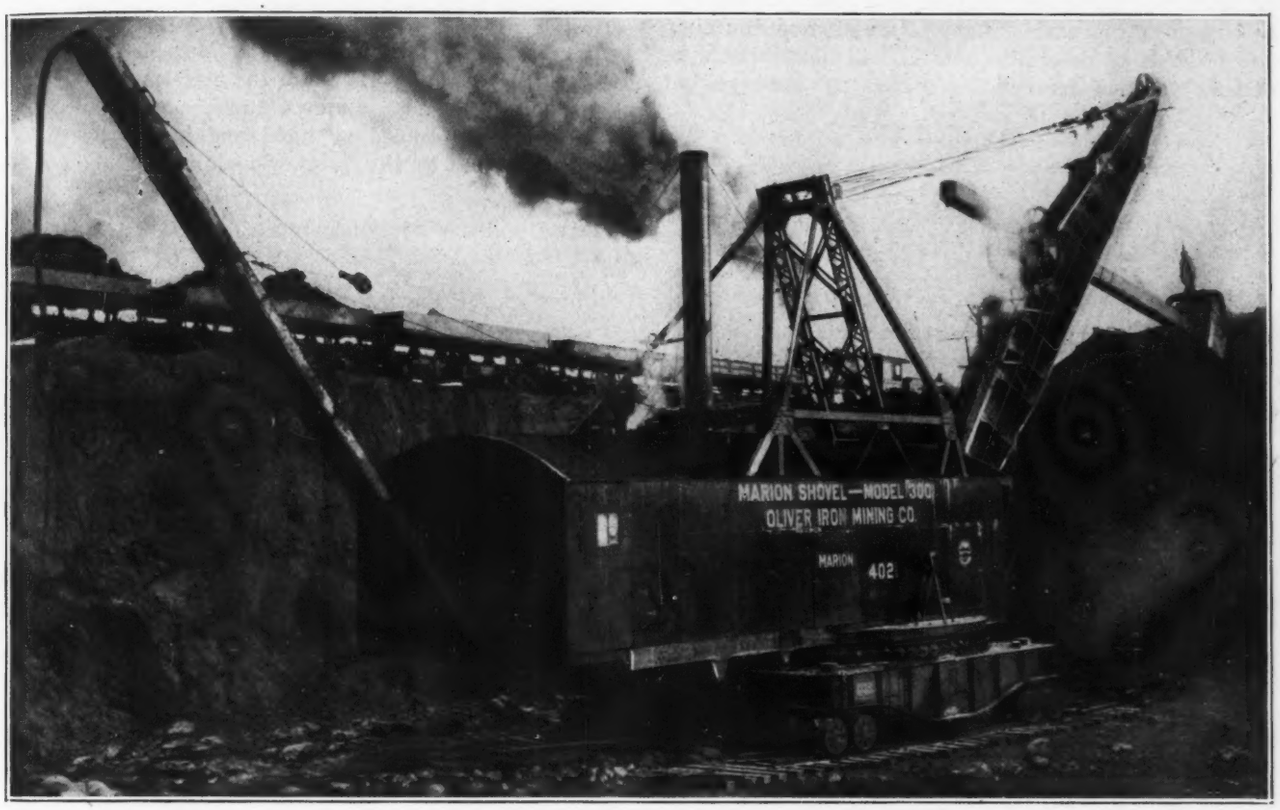


MODEL 300 STEAM SHOVEL DIGGING IN STRIPPING BANK OF MESABI RANGE OPEN-PIT

Steam-Shovel Mining on the Mesabi Range*

By L. D. DAVENPORT
Chief Engineer, Oliver Iron Mining Co., Hibbing, Minn.

Methods that have been used in removing overburden, disposal of the stripping and the subsequent mining of the ore on the Mesabi range of Minnesota have undergone many changes since the beginning of operations. There are today more than 80 open-pits on the Mesabi. The Hull-Rust mine, at Hibbing, is the largest of these, and, with the Mahoning mine, covers 400 acres. Steam-shovel operations are continuous throughout the year. The season for the open-pit mining is limited by the opening and closing of navigation, while most of the stripping is done during the winter months.

THE first exploration work done on the Mesabi range consisted of test pitting, and the shafts were sunk to the water level, whereas at present churn and diamond drills are generally used, and greater depths are explored. A sufficient number of holes is put down to determine the shape and extent of the orebody; samples are taken each five feet in depth and usually analyzed for iron, phosphorus, silica, manganese and alumina. From the drill records, cross-sections of the orebody are made which show the layers of overburden and bessemer, non-bessemer and lean ore, paint rock, slate and taconite. (A complete description of the exploration work, classification of ore material and the platting of the data on cross-sections has already been published.)[1] Maps showing the top and bottom contours of the orebody are then made from the exploration cross-sections. The tonnage of bessemer, non-bessemer and lean ore is estimated from the cross-sections, by

*The first of a series of three articles describing present practice of the larger mining companies in developing and operating open-pit mines on the Mesabi range.

[1]"Orebodies of the Mesabi Range," by J. F. Wolff, E. and M. J., July 17, 24, 31 and Aug. 7, 1915.

the average depth method or a combination of both systems of computation.

The next step is to determine the method of mining best suited to the orebody in question, which is usually done by assuming each drill hole to be a column 1 sq.yd. in cross-section, so that each three feet in depth represents 1 cu.yd of material. Knowing the comparative cost per cu.yd. of removing surface, overburden rock and paint rock, that of mining ore with steam shovels and the cost of milling and of straight underground mining, it is possible to determine which drill holes should be included in the area to be mined by the open-pit

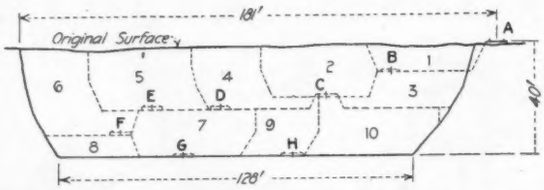


FIG. 1. CROSS-SECTION OF CUT MADE BY MODEL 300, AND CUTS REQUIRED TO REMOVE SAME AREA WITH MODEL 91 SHOVEL

method. This information, when platted on a surface map, gives a preliminary outline of the pit. To determine the final outline of the area to be stripped requires a careful study of the orebody, considerable experience and possibly further drilling. Aside from the comparative cost data on each drill hole, other factors that influence the final outline of the pit are railroad connections, possible ore yards, location of dump ground, operations on adjoining property and general topographical conditions. In determining the stripping limits it is customary to allow a 1:1 slope for the stripping banks, with a 20-ft. berm from the toe of the stripping to the crest of the ore. In many cases this allowance has proved inadequate, the average slope being nearer to 1½:1 on stripping banks which have been standing for several years.

Whenever Possible, Pit Approach Is Planned to Allow Complete Extraction of Available Ore

The position of the pit approach is a matter which requires careful study, as frequently one approach is used for both stripping operations and removal of ore. Whenever possible the approach is planned so that it can be used, with future changes in grade, until all the available ore has been mined. On the other hand, the demand for production may necessitate a temporary approach which will make only a part of the orebody available. In some of the larger pits a permanent stripping approach, as well as one for the removal of the ore loads, is necessary. After the ultimate alignment of the ore tracks has been worked out and platted on the map, cross-sections are made and an operating estimate is prepared which shows the following: (1) Stripping yardage (overburden, lean ore and paint rock, solid rock); (2) steam-shovel ore (includes all ore available for removal by steam shovel); (3) milling and scram ore (includes all ore not available for removal by steam shovel lying inside a ½:1 slope from the crest of ore line); (4) underground ore (includes all ore not falling in the two preceding classes).

As a rule the first field work is staking out the stripping limits and cross-sectioning the area to be stripped. This is locally referred to as "taking original levels," and the elevations so obtained are used later in the monthly yardage estimates. Determining the position of the stripping and dump tracks, coal track and dock, supply tracks, repair or "rip tracks," water tank and pipe lines, dump trestles and surface drainage ditches and the eventual staking out of all these are some of the problems for the engineer to solve.

Demand for Larger Stripping Equipment

The first stripping work on the Mesabi range was done with teams and scrapers or the material was loaded by hand into wagons. Later 1 cu.yd. cars running on light rails were loaded by hand and hauled by team. The next step was the "dinkey" equipment shown in Table I.

TABLE I. DINKEY EQUIPMENT USED IN MESABI STRIPPING

Capacity of Cars Cu.Yd.	Dinkey Locomotives Tons	Steam-Shovels Model	Capacity of Dipper Cu.Yd.
3	8–9	45–50	1½
5	10–15	60	1½

This type of equipment was used until larger shovels having dippers of 2-cu.yd. capacity were introduced, when the 36-in. gage dinkey locomotives and cars were replaced by standard-gage equipment. Table II shows the general increase in the size of stripping equipment up to the present time. The association of certain sizes of locomotives with certain types of shovels is a general classification, many different combinations of locomotives, cars and shovels being in use at the present time. One striking feature in connection with the increase in size of equipment is the decrease in the number of men employed on the stripping dumps.

The first dinkey equipment required a dump crew of 50 men, whereas with the present use of large dump

TABLE II. COMPARISON OF MESABI STRIPPING EQUIPMENT

Capacity of Cars, Cu.Yd.	Locomotives — Size of Cylinder, In.	Locomotives — Weight, Tons	Steam Shovels — Model	Steam Shovels — Weight, Tons	Capacity of Dipper, Cu.Yd.
7	17x24	73	60–65	70–75	2
7	17x24	73	70–80	83–110	2½
12–20	19x26	105	91	107–123	2½–4
16–20	20x26	136	100	138	5
20	20x26	136	300	360	6–8

spreaders, only two men are needed. Fig. 1 shows a cross-section of a single cut taken with a Model 300 steam shovel. The loading track was laid on the surface of the ground as shown at *A*, and on this particular

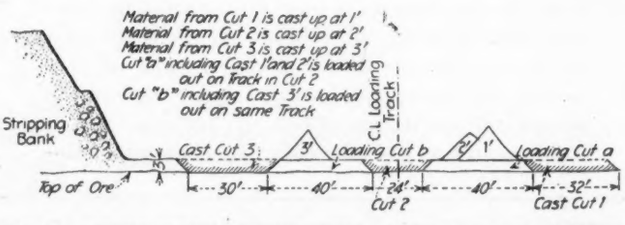

Material from Cut 1 is cast up at 1'
Material from Cut 2 is cast up at 2'
Material from Cut 3 is cast up at 3'
Cut "a" including Cast 1 and 2 is loaded out on Track in Cut 2
Cut "b" including Cast 3' is loaded out on same Track
Stripping Bank
Cast Cut 3
3'
Loading Cut b
2'
1'
Loading Cut a
C.L. Loading Track
Top of Ore
30'
40'
24'
40'
32'
Cut 2
Cast Cut 1

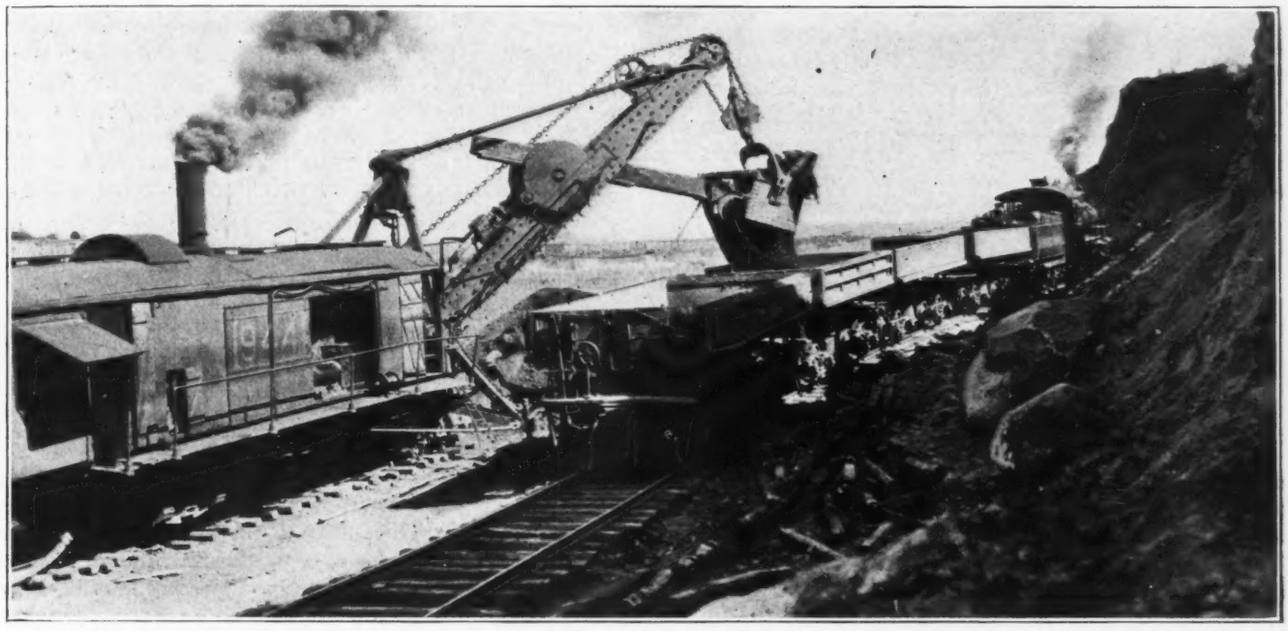
FIG. 2. CROSS-SECTION SHOWING METHOD OF REMOVING A SHALLOW CLEAN-UP WITH MODEL 91 SHOVEL

cross-section the shovel had sufficient reach to push the accumulated spill from the cars clear of the further rail of the loading track. The divisions marked from 1 to 10 show the cuts that would have been necessary had the same cross-section been removed with a Model 91 shovel, and the loading tracks for the different cuts are lettered from *A* to *H*. Track *A* is the loading track for the first cut, track *B* for the second cut, track *C* for the third and fourth, and so on.

Two 10-hour shifts, with the men changing from the day to the night turn every two weeks, are general in open-pit work on the Mesabi range. The length of the shipping season is limited by the opening and closing of navigation on the Great Lakes and usually extends from early in April to about the middle of November. While considerable stripping is done during the shipping season, many of the mining companies confine their summer work to the removal of ore and leave the stripping operations for the winter season, for by this arrangement they can keep their organizations employed the entire year. Usually the same equipment, with the exception of cars, is used in stripping as in digging ore.

The position of the first shovel cut depends entirely on the conditions that are met with on each stripping job. Sometimes, where the surface is irregular, a thorough cut is cast through the center of the pit with the shovel cutting on grade. A track is laid behind the shovel and serves as a loading track for the next two cuts, one on each side. Again, the first track may be laid on the surface of the ground and the dirt from the first cut loaded into cars instead of being over-cast. If, however, the first cut is cast, a uniform grade is obtained, facilitating the building of the first loading track, which in turn serves for two cuts of an average depth of 12 ft. Laying the first track on rough ground requires considerable trackwork, and the irregularities of the roadbed cause heavy wear on the locomotives and cars. The shovel cut tends to follow the undulations of the loading track, and unless carefully watched the profile of the excavation will be very irregular. However, with this method, all dirt handled by the shovel is loaded from the start, and this practice is customary where the surface is fairly uniform. In deepening the pit 25- to 30-ft. benches are dug to the height of the shovel boom. In the general run of overburden, if higher benches are carried, the dipper tends to undercut the bank, causing it to suddenly cave and bury the pit crew or make a costly delay in digging the shovel out.

Stripping approaches are frequently cut where convenient, but the lower cuts and the final clean-up are usually handled through the ore approach unless a permanent stripping approach is found necessary. When it is possible to dig the lower shovel cuts nearly parallel to the surface of the ore, a fairly uniform clean-up of the remaining overburden can be left. An average thickness of six to eight feet of clean-up usually gives the best results, as a bank of only three or four feet requires too many shovel moves per train and thus practically ties up one locomotive. On the other hand, with a clean-up cut of more than eight feet, considerable dirt is spilled along the loading track, necessitating a large amount of scraper work. Where a 3- or 4-ft. clean-up has been left, casting a few cuts will prevent delaying a locomotive. Fig. 2 shows a cross-section of a shallow clean-up cut removed with a Model 91 shovel. When the surface of the ore is irregular, the clean-up shovel may often cut through a knoll of ore, and then after a few moves it will be necessary to crib up the track with several layers of ties to support the shovel over a sag in the ore surface. Ore cut by the clean-up shovel is usually stockpiled in a cleaned part of the pit. The final cleaning of the ore surface is done with teams and scrapers and by hand work.



TAKING A CLEAN-UP CUT WITH A MODEL 91 STEAM SHOVEL

When stripping operations are started, it is customary to protect the cuts from surface drainage by means of ditches, which vary in size, according to local conditions, from steam-shovel cuts to small ditches that follow the contour of the ground and are dug by hand. Water in the pit is pumped into the nearest surface ditch, small portable boilers supplying steam to the pumps.

Shallow holes, known as "top" holes, are used in stripping to break the frost. These are sunk with jumper or hand-drills that have been heated to a dull red, and in badly frozen ground steam points have been used. The depth of the holes will vary from three to six feet. The charge used in blasting consists of six to eight pounds of du Pont black powder per hole, depending on the ground. In some cases it is advisable to loosen the

surface of the stripping for a considerable area by drilling holes 3 to 5 ft. deep and blasting with light charges of powder before the frost sets in. The air spaces in the ground thus loosened prevent hard freezing. Stripping banks 15 ft. or more in height are shaken up ahead of the shovel by blasting "gopher" holes. These holes are started at the toe of the bank and are pointed downward at angles of 5° to 10° from the horizontal. "Gopher" holing, when first used, consisted in making the holes large enough to permit a man to enter and work, but frequent accidents caused this method to be abandoned, and "gopher" holes at the present time have an average diameter of about 15 in. Loose ground is removed with a No. 2 round-pointed shovel blade, the edges of which are slightly turned up, fitted with a 25-ft. handle of 2- or 3-in. diameter. When a hard seam is encountered, it is drilled with a long auger or with a moil, and one or two sticks of dynamite are pushed in

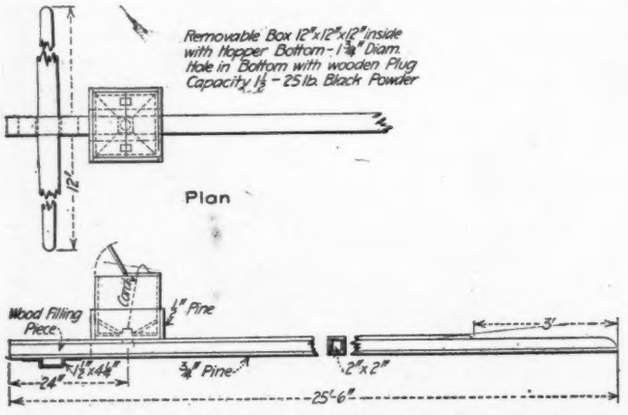


FIG. 3. DEVICE FOR LOADING "GOPHER" HOLES

with a pointed loading stick and fired with a blasting machine. The loose ground is then removed with the shovel. If a boulder is struck while the "gopher" is being driven, repeated blasting with 60% dynamite will often shatter it sufficiently to allow the hole to be continued. Where it is impossible to blast through a boulder, the hole is bottomed against it, or a new hole is begun a few feet away, depending on the length attained. The limit of length of a "gopher" hole is about 25 feet.

In winter the top of the banks freezes as deep as eight feet. Unless this crust is broken by top drilling before "gopher" holing is done, the latter usually undercuts the bank, causing slabs of frozen ground to slide down and bury the loading track. It frequently happens, even where the frost has been broken, that chunks too large to be handled by the shovel roll from the bank to the track and have to be block-holed by drilling with a steam hose or hot moils and then blasted.

Care Observed in Blasting

The powder boss determines the size of the powder charge from the height of the bank and the material encountered in digging the hole. With a 25-ft. bank, 15 to 25 sticks of dynamite are used to "spring" or chamber the hole, which is then loaded with 5 to 10 kegs (25 lb.) of black powder. Wooden spoons, 3-in. x 3-in. in cross-section, 2½ ft. long and fitted with 25-ft. handles, are sometimes used to place the powder in the holes. Long wooden launders 2 in. square with a hopper at one end, as shown in Fig. 3, are in general use. A keg of powder is emptied into the hopper, the cover shut and a plug closing the bottom of the hopper is pulled by means of a cord through the cover. The box is oscillated by a 12-ft. cross-handle, causing the powder to run down the launder into the chamber of the "gopher" hole. The long cross-handle allows the powder men to stand six feet on either side of the hole, instead of directly in front, as was necessary with the old-style spoons. Furthermore, the closed hopper protects the powder from the danger of sparks. A detonator, consisting of two to five sticks of 60% dynamite with two exploders, is placed in the center of the charge. Two electric blasting caps, or else one electric and one ordinary blasting cap and fuse, are placed in each hole. The latter combination is in more general use for the reason that tamping sometimes injures the lead wires from the electric caps. Holes are filled and tamped to the collar with sand or gravel and are fired in batteries of three to five at a time. The distance between holes is usually 20 to 25 ft., and the depth of the holes varies according to the shovel cut to be taken. The general rule is to make the horizontal distance between the center of the loading track and the chamber of the "gopher" hole five or six feet less than the reach of the shovel. For example, with a Model 91 shovel the distance from the center of the loading track to the bottom of the hole should be 40 ft., as the shovel reach from loading track to toe of bank is about 45 feet.

Jackhamer Machines in Common Use for Drilling Boulders in Pit

When the shovel encounters boulders too large to be loaded, they are rolled to one side of the cut and left until drilled by "single-jackers" who work on contract and average about 15 ft. per shift in granite. Blasting is done by the company powder man, using 60% dynamite. When a large boulder is partly uncovered in the bottom of a cut and projects so that it interferes with the shovel track or the jack-arms, there are several ways of removing it. One practice, formerly common but now seldom used, is to "bulldoze," that is to place 25 to 75 lb. of dynamite on the boulder and blast. Needless to say, this method frequently injured the shovel. Often a small "gopher" hole can be dug under the boulder on a side away from the shovel and charged with black powder. When blasted, the ground will frequently be loosened enough to allow the dipper to roll the boulder to one side. Some stripping contractors have provided one or more drills of the jackhamer type on each shovel. Air is supplied from an air pump or the compound pump on a locomotive, and the boulder is block holed.

(To be continued)

Vermont Talc Industry during 1917 was extremely active, all of the producers being sold to capacity during the entire period. Approximately 70% of the production of Vermont was mined and manufactured by the Eastern Talc Co., the remainder of production being furnished by the American Mineral Co., Magnesia Talc Co., Vermont Talc Co. and one or two smaller producers. Prices of the lower grades of talc averaged from 15 to 20% above those previously prevailing, while in the higher grades advances ranged as high as 25%. These advances have not entirely covered the increased cost of labor and supplies and contracts for 1918 were made at advanced figures.

Estimation of Manganese in Aluminum Alloys and Dust

By J. E. CLENNELL*

Known gravimetric or volumetric methods of estimating manganese after its separation from accompanying metals proved too slow or too complex for general use. Two methods are therefore described of determining manganese which do not require its separation from all other constituents. Both involve titration with sodium arsenite solution, the proper conditions for standardizing which were carefully worked out as described.

ANALYSES made in the laboratory where the experimentation here detailed was conducted show that manganese is a frequent constituent of aluminum alloys. When these are used for the manufacture of dust, a large part of the manganese finds its way into the final product. Some of it may be eliminated in the melting process; on the other hand, an additional quantity may possibly be introduced, together with iron, from the wear of manganese-steel balls in grinding; thus one generally finds that when alloys high in manganese are used the dust contains less than the raw material, but when little or no manganese is found in the alloys, the dust contains more than the raw material.

In separating manganese from other metals in the routine analysis, the determination is made on one gram of the dust. After removal of grease by means of ether, the dust is dissolved in dilute hydrochloric acid with addition of a little nitric acid, and any insoluble residue filtered off. The filtrate, which should be hot, but not actually boiling, is treated with excess of caustic soda, sufficient to redissolve the alumina first thrown down. A dark-brown precipitate remains undissolved, consisting of the hydroxides of iron, manganese, copper and magnesium. This is allowed to settle, filtered and washed with hot water. The filtrate contains alumina, zinc and a trace of iron.

Separation of Manganese from Iron, etc., in the Precipitated Hydroxides

Various methods for the separation of manganese in this precipitate were investigated in the laboratory. As is well known, the separation of iron from manganese by ammonia and ammonium chloride is always imperfect. It was thought that possibly a sufficiently good separation might be made by two or more repetitions of the process, consisting of dissolving the precipitate in HCl, adding excess of ammonia, boiling and filtering. After three or four cycles of this procedure, the filtrate no longer showed any appreciable reaction for manganese when tested by adding bromine water and boiling. The final precipitate, however, when dissolved in nitric acid and tested by boiling with lead peroxide, gave a strong manganese reaction. It would seem, therefore, that when the relative proportion of iron is very large the manganese is completely precipitated by ammonia along with the iron, notwithstanding the presence of considerable quantities of ammonium chloride.

Tests were made on a method of separation by means of ammonium carbonate, described by Fresenius.[1] The precipitate is dissolved in HCl, nearly neutralized with ammonia, a considerable quantity (one or more grams) of ammonium chloride added and the solution diluted to about 200 c.c. Ammonium carbonate is then added in sufficient quantity to the slightly acid liquid to produce a faint cloudiness, but no distinct precipitate. The solution is then boiled thoroughly to expel CO_2, when the iron is precipitated as a light red basic carbonate, leaving the manganese in solution. The precipitate is allowed to settle, then filtered and washed with hot dilute ammonium chloride. It was found that, while it is possible to get a good separation by this method when all the necessary precautions are carefully attended to, it is too troublesome and tedious for general use. If much iron is present, the first precipitate must be redissolved in HCl and reprecipitated with ammonia, or even with ammonium carbonate, as in the first operation. The filtrate must also be examined by adding excess of ammonia and boiling, in all cases.

Procedure in Zinc-Oxide Method of Separation

Attention was then directed to the zinc-oxide method of separation. The method followed was more or less on the lines of that described by A. H. Low,[2] but it was found that it is unnecessary to boil down with sulphuric acid. The presence of zinc in the filtrate from the ferric hydroxide seems to interfere with the direct precipitation of manganese by bromine; instead of the usual dark-brown hydroxide, a light-brown precipitate occurs, and the precipitation is incomplete. Addition of ammonia causes a precipitate, presumably zinc hydroxide, which redissolves only in considerable excess. Good results are obtained, however, by using sodium acetate, as described by Low. Another trouble which sometimes occurs is that the precipitate of mixed iron and manganese hydroxides fails to dissolve completely in HCl, spots remaining on the paper which obstinately resist the action of the acid. I have found that this can be remedied by adding one or two drops of a concentrated solution of sodium sulphite, which causes the stains to disappear instantly.

Finally the following procedure was found satisfactory: After precipitating with caustic soda, as in the routine method, wash once or twice with hot water, dissolve the precipitate from the paper by means of hot 50% HCl (about 10 c.c. usually suffices) adding a few drops of concentrated sodium sulphite and collecting filtrate in a clean 250-c.c. flask. Wash three or four times with hot water. Add 1 or 2 c.c. concentrated HNO_3 and heat to boiling to peroxidize iron; add excess of ammonia, then about 10 c.c. of strong bromine water;

*Analytical and metallurgical chemist with Charles Butters & Co., Oakland, Calif.

[1]Quantitative Analysis, seventh edition, Vol. 1, p. 437.
[2]Technical Methods of Ore Analysis, fifth edition, p. 162.

boil thoroughly, settle a few minutes, filter and wash with hot water. The iron and manganese are completely precipitated together, leaving magnesium and copper (if not previously removed) in the filtrate. The precipitate is then redissolved in HCl, the sulphite being again added if necessary, and, if this is done, followed by boiling with addition of a little HNO_3 to ensure the conversion of iron into the ferric state. Sodium carbonate or caustic soda is then added, a little at a time, until the precipitate is permanent on agitation, then HCl is added until the solution just clears. Pure zinc oxide is next added, with agitation and boiling until the ferric hydroxide settles in a colorless liquid and a little zinc oxide remains undecomposed. By nearly neutralizing as above, the iron may be precipitated without the necessity of using a large amount of zinc. After settling a few minutes, the mixture is filtered and washed thoroughly with hot water. Tests made on the residue, by dissolving in nitric acid and boiling with lead peroxide, showed that the separation of manganese was practically perfect.

To the filtrate add one gram of sodium acetate and, say, 10 to 15 c.c. of strong bromine water. Boil thoroughly, settle a few minutes, filter and wash with hot water. It is also well to test the filtrate by further additions of sodium acetate and bromine, although the precipitation was generally found to be complete in one operation, the manganese coming down as a dark-brown hydroxide.

Estimation of Manganese

The manganese, now being precipitated in a practically pure condition as hydroxide, may be estimated by any of the well-known gravimetric or volumetric methods. For gravimetric estimation, perhaps the best procedure is to redissolve the hydroxide in HCl, precipitate as carbonate, filter, wash, ignite and weigh as Mn_3O_4, or else dissolve in HCl, precipitate as phosphate in presence of excess of ammonia, boil, cool, filter, wash with ammonium nitrate and ammonia, ignite and weigh as $Mn_2P_2O_7$.

Many volumetric methods have been described and several have been tested in the laboratory where the results here set down were obtained, as regards their applicability to aluminum alloys and dust. The methods so tested were:

1. That depending on the oxidation of oxalic acid (Low, Technical Methods of Ore Analysis, fifth edition, pp. 162-166).
2. Volhard's method, depending on the titration of a manganous salt with permanganate (Low, *loc. cit.*, pp. 167-169).
3. A method depending on oxidation to permanganic acid by the use of ammonium persulphate, and titration with an arsenite solution.

Oxalic Acid Method

The filter paper containing the moist hydroxide precipitate is transferred to a flask and a measured quantity of standard oxalic acid in excess of that required for the reaction is added, then dilute sulphuric acid (say 50 c.c. of 12% H_2SO_4), and the mixture heated with agitation till the manganese hydroxide has completely dissolved. The liquid is then titrated, while still hot, with standard permanganate. A blank test is made, using the same quantity of standard oxalic and sulphuric acids and a filter paper of the same kind as in the assay, and treating in the same way. The difference of the two titrations corresponds to the amount of oxalic acid oxidized by the manganese dioxide present in the precipitate, and is therefore proportionate to the amount of manganese present.

As will be observed, this is an indirect method, and involves the use of two standard solutions, of which the manganese equivalent must be known. With care it gives accurate results, though in some cases it appears doubtful whether the manganese is all in the form of dioxide or whether it may not be partly thrown down as some lower oxide. In any case a simpler method is desirable.

Volhard's Method

An attempt was made to apply Volhard's method direct to a sample of aluminum dust as follows: 1 gram of the dust was dissolved in sufficient 50% HNO_3, about 50 c.c. of 50% acid being required. H_2SO_4 was then added and boiled to fumes, diluted, neutralized with sodium carbonate and finally with zinc oxide, made up to a definite volume (500 c.c.) and an aliquot part taken. This, however, gave no precipitate on adding standard permanganate, the first drop of the latter producing a permanent pink coloration. Apparently the large amount of aluminum and other salts interferes with the reaction. The method could probably be successfully applied to the mixed iron and manganese hydroxides obtained in the routine analysis, but would present no special advantage in rapidity or accuracy over the oxalic acid method.

Ammonium Persulphate Method

As none of the foregoing gravimetric or volumetric methods are sufficiently rapid or simple for regular use, a process was sought which would permit the estimation of the manganese without the necessity of separating all or most of the other constituents. The following method was communciated to me by Mr. Liljegren, chemist of Hunt & Co. I give the method as described by him:

"Take 500 mg. of aluminum dust. Remove grease with ether. Dissolve in 45 c.c. nitric acid (sp.gr. 1.20) equivalent to 5 parts concentrated HNO_3 and 11 parts water. Boil till nitrous fumes are driven off. Add 50 c.c. water and 15 c.c. silver nitrate solution (1.33 gram per liter). Bring to a boil. Add 20 c.c. of an ammonium persulphate solution containing 32 grams per liter. Heat just to boiling. Cool quickly and titrate with dilute sodium arsenite, till pink tint disappears.

"The strong stock solution of sodium arsenite is made by dissolving 10 grams of arsenious acid (As_2O_3) and 30 grams of sodium carbonate in boiling water, and when dissolved, cooling and diluting to 1000 c.c. To prepare the dilute standard solution, 62.5 c.c. of this stock solution are diluted to 1000 c.c. One cubic centimeter of this standard arsenite solution = 0.1% Mn approximately, on an assay of 500 mg. The solution is standardized on steel of known manganese content."

It will be observed that the method is extremely simple and rapid. It depends on the formation of permanganic acid by the action of ammonium persulphate on the manganese compounds present in the nitric acid solution. The silver salt is supposed to act as a catalytic agent, but it is also useful in precipitating any trace

of chloride, which would otherwise reduce the permanganic acid.

In the case of alloys, where the sample is received in the form of clippings, filings or drillings, it is not practicable to dissolve in nitric acid alone in any reasonable time, and in such cases I have used aqua regia, expelling the last traces of chlorine by evaporating once or twice with concentrated HNO_3 nearly to dryness.

My experience with ammonium persulphate was far from satisfactory. In a few cases the color was developed under the conditions above described, but more often no effect whatever was obtained. Sometimes a pink tint would form momentarily, but the liquid would almost immediately become turbid, with precipitation of brown manganese hydroxide. This latter effect could generally be prevented by addition of sufficient sulphuric acid, but the action was so uncertain and unsatisfactory that the use of ammonium persulphate was finally abandoned. It seems possible that this failure to obtain a good reaction may be due to some deterioration of the reagent by long keeping, but as I have been unable to obtain a fresh supply this point has not been verified.

Estimation of Manganese by Lead Peroxide Method

As a substitute for ammonium persulphate, lead peroxide was tried in the series of tests detailed below. Great difficulty was at first experienced in getting consistent results, but finally a method was evolved which seems to be generally applicable to aluminum dust or fine granules, and to be accurate enough for all practical purposes. The procedure at present recommended as the final result of these tests is as follows:

Take 1 gram of the sample in a 300 c.c. flask. Add 50 c.c. of 50% nitric acid. Heat gently with constant agitation until violent action sets in, with copious evolution of red fumes. Withdraw from heat and cool, if necessary, until this is over; then boil to expel red fumes. Filter into another 300 c.c. flask. Rinse first flask out once or twice with hot water, passing washings through filter. Place filter paper in a nickel crucible, dry, ignite and add enough sodium peroxide to cover the ash. Fuse at a gentle heat for about one minute. Dissolve the melt in water, and add the solution to the liquid in the second flask containing the nitric-acid extract. Boil well; add about 1 c.c. standard $AgNO_3$[a] to ensure absence of chlorides and again boil for a moment. Add 100 mg. lead peroxide for every milligram of manganese supposed to be present. Boil one minute, cool, make up to 100 c.c. and mix thoroughly. Let settle about five minutes and filter. Titrate 50 c.c. of the filtrate with standard sodium arsenite.

Occasionally some of the precipitate passes the filter and slightly obscures the end point. When this happens it is preferable to refilter before titrating. In any case the first portion of liquid running through should be rejected. The end point is marked by the change from pink to faint yellow, and the same tint must be taken for the end point in standardizing. The method can be carried out in half an hour or less. There is apparently no necessity for preliminary removal of grease.

The arsenite solution may be standardized as follows: Take a measured quantity, say 5 c.c., of the standard permanganate solution used for iron estimation. Add 1 c.c. of a saturated solution of sodium sulphite, which produces a brown precipitate; then 25 c.c. of 50% nitric acid; warm till a perfectly clear and colorless solution is obtained, adding more nitric acid if necessary. Add 50 c.c. of water. Boil thoroughly to expel nitrous acid. Add 1 c.c. standard silver nitrate, then 0.5 gram lead peroxide; boil one minute, cool, make up to 100 c.c., filter, reject first portion of filtrate, draw off 50 c.c. and titrate with the standard arsenite.

TABLE I. TESTS TO DETERMINE PROPER CONDITIONS FOR STANDARDIZING SODIUM ARSENITE SOLUTION

Based on Permanganate Standard

Assumptions: (*a*) 1 c.c. $KMnO_4$ = 1.178 mg. Mn; (*b*) 1 c.c. Na_3AsO_3 = 0.235 mg. Mn.

	(1)	(2)	(3)	(4)	(5)	(6)		— Manganese —	
Test No.	$KMnO_4$ Taken, c.c.	Na_2SO_3 Added c.c.	50% HNO_3 Added c.c.	Water Added c.c.	$AgNO_3$ Added c.c.	PbO_2 Added, Grams	Standard Arsenite for 50 c.c., c.c.	Indicated by 1 c.c. Arsenite. mg. (*a*)	Theoretically Present in Original Solution. mg. (*a*)	Found mg. (*b*)
1	2	1	25	25	1	0.5	4.2	0.280	2.36	1.97
2	5	1	25	25	1	0.5	13.0	0.227	5.89	6.11
3	10	1	25	25	1	0.5	15.5	0.380	11.78	7.28
4	5	1	25	25	1.5	0.25	10.3	0.286	5.89	4.84
5	5	1	25	25	1.5	0.5	12.55	0.235	5.89	5.90
6	5	1	25	25	1.5	0.75	13.5	0.218	5.89	6.34
7	5	1	25	25	1.5	1.0	11.0	0.268	5.89	5.17
8	5	1	25	25	1.5	0.25	10.6	0.278	5.89	4.98
9	5	1	25	25	1.5	0.5	8.4	0.351	5.89	3.95
10	5	1	25	25	1.5	0.75	8.1	0.364	5.89	3.81
11	5	1	25	25	1.5	1.00	12.1	0.243	5.89	5.69
12	5	0.5	50	..	1.5	0.25	1.6	1.841	5.89	0.75
13	5	0.5	50	..	1.5	0.5	7.25	0.406	5.89	3.41
14	5	0.5	50	..	1.5	0.75	7.25	0.406	5.89	3.41
15	5	0.5	50	..	1.5	1.0	10.8	0.273	5.89	5.08
16	5	0.5	25	50	1.5	0.25	11.25	0.262	5.89	5.29
17	5	0.5	25	50	1.5	0.5	12.0	0.245	5.89	5.64
18	5	0.5	25	50	1.5	0.75	11.65	0.253	5.89	5.48
19	5	0.5	25	50	1.5	1.0	13.1	0.225	5.89	6.16
20	5	0.5	25	50	1.5	0.5	12.75	0.231	5.89	5.99
21	5	0.5	25	50	1.5	0.5	11.0	0.268	5.89	5.17
22	5	0.5	25	50	1.5	0.5	13.3	0.221	5.89	6.25
23	5	0.5	25	50	1.5	0.5	12.15	0.242	5.89	5.71
24	5	0.5	25	50	...	0.5	14.2	0.207	5.89	6.67
25	5	0.5	25	50	1.5	0.5	12.25	0.240	5.89	5.76
26	5	0.5	25	50	...	0.5	13.95	0.211	5.89	6.56
27	5	0.5	25	50	1.5	0.5	11.1	0.265	5.89	5.22
28	5	0.5	25	50	...	0.5	12.35	0.238	5.89	5.89
29	5	0.5	25	50	...	0.5	9.65	0.305	5.89	4.54
30	5	0.5	25	50	...	0.5	8.9	0.331	5.89	4.18
31	5	0.5	25	50	1.5	0.5	12.7	0.232	5.89	5.97
32	5	0.5	25	50	1.5	0.5	8.6	0.342	5.89	4.04
33	5	0.5	25	50	1.5	0.5	7.9	0.373	5.89	3.71
34	5	0.5	25	50	1.5	0.5	7.0	0.421	5.89	3.29

Other conditions during the tests were as follows: Tests 1 to 7—Boiled after (3) and (5); one minute after (6). Tests 8 to 11—5 c.c. concentrated H_2SO_4 after (2), otherwise as in tests 1 to 7. Tests 12 to 15—Boiled after (3) and (5); one minute after (6). Tests 16 to 19—(4) added and boiled before (3). Test 20—(3) and (5) added to cold solution; just boiled after (6). Test 21—Boiled after (4) and (5); not after (6). Test 22—Boiled after (4); one minute after (6). Test 23—Boiled after (4); two minutes after (6). Tests 24 and 25—Just boiled after (6). Tests 26 and 27—Boiled one minute after (6). Test 29—5 c.c. ferric sulphate added after (4) and boiled. Test 30—10 c.c. ferric sulphate added after (4) and boiled. Test 31—Boiled after (4); just boiled after (6). Test 32—5 c.c. ferric sulphate added. Test 33—10 c.c. ferric sulphate added. Test 34—15 c.c. ferric sulphate added.

The manganese content of the permanganate may be calculated from the iron factor by multiplying by 0.1967, assuming the following reaction:

$$10FeSO_4 + 2KMnO_4 + 8H_2SO_4 = 5Fe_2(SO_4)_3 + 2MnSO_4 + K_2SO_4 + 8H_2O$$

from which it appears that 5Fe = 1Mn, or 1 part Fe $= \frac{54.93}{5 \times 55.85} = 0.1967$ parts Mn. This being known, the manganese factor of the arsenite solution is readily calculated. For example, in a given case, 5 c.c. of permanganate required 23.2 c.c. of arsenite solution, and the iron factor was 1 c.c. permanganate = 5.967 mg. Fe. Hence 1 c.c. of arsenite $= \frac{5 \times 5.967 \times 0.1967}{23.2} =$ 0.253 mg Mn.

A better method of standardizing seems to be obtained by the use of the manganous nitrate solution referred to in Table II and notes.

Where chlorides are known to be absent, the addition of silver nitrate is unnecessary and is preferably

[a]—13.04 grams $AgNO_3$ per liter.

omitted. Where the amount of manganese is approximately known, the quantity of lead peroxide may be taken proportionately to it, using 100 parts of PbO_2 for every part of Mn present. The conditions in the assay must correspond strictly with those in the standard; otherwise large errors may occur, as will be seen from the experiments described in detail.

In the case of alloys and coarsely ground samples it is necessary to dissolve in aqua regia and expel excess of chlorine by evaporation with nitric acid. The first 15 tests (Table I) gave erratic results, apparently because of insufficient dilution. More regular results were obtained when the volume of liquid was 75 to 80 c.c. at the time of adding the lead peroxide.

The presence of sulphuric acid appears to be detrimental (see tests 8 to 11). Probably the lower results obtained with ferric sulphate are due to the H_2SO_4, as when iron was added in the form of nitrate the apparent per cent. of Mn was not diminished.

Tests 20 to 23 were made to determine the effect of applying heat at different stages of treatment. Tests 24 and 26, in which $AgNO_3$ was omitted, gave a higher result than the corresponding tests 25 and 27, in which $AgNO_3$ was added. The ferric sulphate solution used in tests 29, 30, 32, 33, 34 contained 5% $Fe_2(SO_4)_3$ and 10% H_2SO_4.

The manganous nitrate solution used in these tests (Table II) was prepared by dissolving two grams of chemically pure manganous carbonate in 20 c.c. of 50% HNO_3, adding a few drops of strong sodium sulphite to give a clear solution. This was boiled thoroughly, cooled, and diluted to 100 c.c. Assuming $MnCO_3$ = 47.8% Mn, the standard of this solution should be 0.956 mg. Mn per c.c.

TABLE II. STANDARDIZATION OF SODIUM ARSENITE SOLUTION

Tests Based on Manganous Nitrate Standard

Assumptions: (*a*) 1 c.c. Mn. $(NO_3)_2$ = 0.956 mg. Mn; (*b*) 1 c.c. Na_3AsO_3 = 0.230 mg. Mn; and (*c*) 1 c.c. Na_3AsO_3 = 0.246 mg. Mn.

	(1)	(2)	(3)	(4)	(5)			Manganese	
Test No.	$Mn(NO_3)_2$ Taken c.c.	Ferric Nitrate 1 c.c. = 1 mg. Fe. c.c.	50% HNO_3 Added c.c.	Water Added c.c.	PbO_2 Added Grams	Standard Arsenite for 50 c.c., c.c.	Indicated by 1 c.c. Arsenite mg. (*a*)	Theoretically in Original mg. (*a*)	Found mg. (*b*)	Found mg. (*c*)
1	2	..	25	25	0.5	4.1	0.233	1.91	1.89	....
2	5	..	25	25	0.5	9.6	0.249	4.78	4.42	....
3	7	..	25	25	0.5	12.15	0.275	6.69	5.59	....
4	10	..	25	25	0.5	13.8	0.346	9.56	6.35	....
5	10	..	25	25	0.5	19.95	0.240	9.56	9.18	....
6	5	..	10	65	0.5	6.85	0.349	4.78	3.15	....
7	5	..	25	50	0.5	10.8	0.221	4.78	4.97	....
8	5	..	35	40	0.5	11.0	0.217	4.78	5.06	....
9	5	..	50	25	0.5	10.8	0.221	4.78	4.97	....
10	5	..	25	50	0.5	10.0	0.239	4.78	4.60	....
11	5	5	25	45	0.5	10.4	0.230	4.78	4.78	....
12	5	10	25	40	0.5	10.4	0.230	4.78	4.78	....
13	5	20	25	30	0.5	10.6	0.226	4.78	4.88	....
14	5	50	25	..	0.5	9.7	0.246	4.78	4.46	....
15	2	..	25	50	0.5	4.25	0.225	1.91	1.95	....
16	5	..	25	50	0.5	10.45	0.229	4.78	4.81	....
17	7	..	25	50	0.5	14.05	0.238	6.69	6.46	....
18	10	..	25	50	0.5	17.8	0.269	9.56	8.19	....
19	2	..	25	50	0.2	4.1	0.233	1.91	1.89	2.02
20	5	..	25	50	0.5	9.7	0.246	4.78	4.46	4.77
21	7	..	25	50	0.7	13.7	0.244	6.69	6.30	6.74
22	10	..	25	50	1.0	19.2	0.249	9.56	8.83	9.45
23	5	..	25	50	0.5	9.9	0.241	4.78	4.55	4.82
24	5	..	25	50	0.5	10.2	0.234	4.78	4.69	5.02

Other conditions during the tests were as follows: Tests 1 to 5—Boiled after (4) and (5). Tests 6 to 9—Boiled after (4) and one minute after (5). Tests 10 to 14—As in tests 6 to 9, but settled 45 min. before filtering. Tests 15 to 22—Boiled after (4) and one minute after (5). Test 23—One gram Al dissolved in HNO_3 added before (2). Test 24—25 mg. paraffin wax added before (2).

The standard ferric nitrate solution was made by dissolving 125 mg. of pure iron wire in 10 c.c. 50% HNO_3, adding 5 c.c. concentrated HNO_3, boiling thoroughly, cooling and making up to 125 c.c., so that 1 c.c. = 1 mg. Fe.

The irregularities in the first five tests are probably due to insufficient dilution at the time of adding the PbO_2. Tests 7, 8 and 9 show that uniform results may be obtained with varying amounts of nitric acid beyond the necessary minimum. In test 6 the amount of acid was apparently insufficient.

Tests 10 to 13 show that ferric iron does not affect the results up to the amounts likely to be present in the samples to be tested. Tests 15 to 18 show a diminishing amount of Mn compared with the amount theoretically present, as this amount is increased. This is evidently due to insufficient lead peroxide. Tests 19 to 22, in which the PbO_2 was varied according to the amount of Mn present, show fairly concordant results. About 100 parts of PbO_2 for each part of Mn seem to be required. Test 23 shows that aluminum, up to the amount that would be present in an assay, does not interfere. Test 24, in which grease was added, shows a slightly higher result than the corresponding test without.

Tests in this series (Table III) were made on a sample representing 580 cases of 160-mesh aluminum dust, containing iron 2.15%, copper 0.2%, and grease 1.06%. The object was to determine the best conditions for preparing the sample for the titration of manganese by the lead peroxide method. It will be observed that low results were obtained when the residue that was insoluble in HNO_3 was rejected, as in test 3, or left undecomposed, as in test 5. Tests 1, 2, 4 and 8 agree within the probable limits of variation of the sample. Probably the method used in test 4 is preferable, as it entirely eliminates the introduction of chlorides, and is simpler and quicker than those used in test 1 or 2.

TABLE III. MODIFICATIONS OF LEAD PEROXIDE METHOD ON ALUMINUM DUST

Assumption: 1 c.c. Na_3AsO_3 = 0.235 mg. Mn.

Test No.	Treatment	Arsenite on 50 c.c. c.c.	Manganese Indicated, %
1	Dissolved in 50 c.c., 50% HNO_3, filtered, washed twice with hot water. Filter paper treated with aqua regia and extract boiled down with HNO_3 and added to main filtrate; 1 c.c. standard $AgNO_3$ added and solution boiled	7.1	0.334
2	As in test No. 1, but after treatment with aqua regia as above, filter paper was ignited in nickel crucible, ash fused with sodium peroxide, melt dissolved in water and added to aqua regia extract; 1 c.c. $AgNO_3$ added	7.0	0.329
3	Dissolved in 50 c.c., 50% HNO_3, filtered, washed twice with hot water and filter paper rejected; 1 c.c. $AgNO_3$ added and solution boiled	6.55	0.308
4	Dissolved in 50 c.c., 50% HNO_3, filtered, washed twice with hot water. Filter paper ignited in nickel crucible, ash fused with sodium peroxide. Melt dissolved in water and added to the original filtrate; 1 c.c. $AgNO_3$ added	7.2	0.338
5	Dissolved in 50 c.c., 50% HNO_3, 25 c.c. water added, then 1 c.c. $AgNO_3$. Boiled without filtering	6.45	0.303
6	As in test No. 4, but $AgNO_3$ omitted	6.8	0.320
7	Dissolved in 50 c.c., 25% HCl + 10 c.c., 50% HNO_3, filtered, washed twice with hot water. Filter paper treated as in test 4. Filtrate precipitated with NaOH + Br. Refiltered. Residue dissolved in 25 c.c. 50% HNO_3. Boiled, added 50 c.c. water and 1 c.c. $AgNO_3$	7.8	0.367
8	See notes	7.1	0.334

In each of the above tests, one gram of aluminum dust was used. In each case after treating as described above, 0.5 gram PbO_2 was added, solution boiled one minute, cooled, diluted to 100 c.c., filtered, and test made on 50 c.c.

The higher result of test 7 is at present unaccounted for. In this case the bulk of the Al had been removed in the first stages of treatment, but, as shown by test 23 in Table II, the presence or absence of Al should not affect the Mn determination. The NaOH and other reagents used were examined for Mn with negative results. In test 8 the routine method was followed, the sample being dissolved in 50 c.c. 25% HCl and 10 c.c. 50% HNO_3. Insoluble matter was brought into solution by treatment with sodium peroxide, and the Mn finally separated by the zinc-oxide method, and precipitated by Br. This precipitate was then dissolved in 25 c.c. 50% HNO_3 and a little Na_2SO_3, 50 c.c. water and 1 c.c. $AgNO_3$ added.

The Mining Districts of Joplin and Southeast Missouri—III*

By H. W. KITSON

Silicate ores occur near the surface and are mined mostly by hand-steel methods. "Upper run" sulphide deposits are mined by heavy-timber methods and are known as "soft-ground" mines. Open stoping by undercutting from raises, and the square-set system, are also used where ground conditions permit. "Sheet-ground" and interbedded tabular deposits are mined by open stopes and pillars, from vertical shafts, hoisting with buckets, and producing at a low cost per ton.

THE silicate ores of the Joplin district occur in the weathered zone above ground-water in limestone. They are irregular and pockety orebodies and for the most part mined by hand-steel methods and the ores sorted underground. Mines in the "upper run" sulphide orebodies are practically exhausted, but in the early days of the Joplin district constituted the main source of production. These deposits were for the most part in what are known as "soft-ground" mines, necessitating, as the name suggests, the use of timber, as distinguished from those that were minable by the support only of pillars. The deposits were high grade, but pockety and irregular, and the ground when soft was also wet. Many of the orebodies deposited along the contacts of shale in limestone sink holes had an elongated form, sometimes of considerable length and width; and they often occurred with a circular strike following the peripheral contact and forming the so-called "circle" deposits.

Large pockets containing nearly pure galena and blende were frequently found associated with a dark secondary chert filling cavities and fractures. A form of soft white decomposed chert locally known as "cotton rock," and decomposed shale or "soapstone," often formed the walls and roof. When to this condition was added the considerable amount of moisture and mud, stoping was difficult, and such mines required heavy timbering, close-lagged and often spiled, and shafts frequently had to be cribbed solidly for their entire depth. Where the ground permitted, square sets were used in stoping. These mines were sometimes deep enough for more than one level. Where the ground would stand, the ore was followed from the lowest level to the upper limits with inclined raises. When completed, the raise bottoms were undercut in benches progressively for the length of the raise, leaving high walls behind. The ore as broken fell to the bottom, where it was shoveled into "cans" or buckets set on trucks, trammed to the shaft and hoisted in the buckets. Stopes of this character were often over 60 ft. high and sometimes 40 ft. wide.

FIG. 1. UNDERGROUND HAULAGE IN THE JOPLIN DISTRICT WITH STORAGE-BATTERY LOCOMOTIVE.

The ores mined at present occur mainly in the sheet-ground deposits of the Grand Falls chert and the interbedded deposits of the western part of the field. The methods used in mining are similar in both cases, there

*Continued from Part I, Dec. 22, 1917, and Part II, Feb. 23, 1918; to be followed by Part IV, on milling in the Joplin District.

being from a mining point of view but little difference in shape, depth or self-supporting character of the ground. As the details of *modus operandi* of churn drilling operations and mining methods are already well described in a recent paper[1] by H. I. Young, general discussion and further observations only will be undertaken.

The deeper orebodies are prospected altogether by churn drill. The cuttings, when "shines" (sulphides) have been reached, are sampled and assayed. By operating two or more rigs working radially from an initial central discovery hole, drilling on the corners or squares

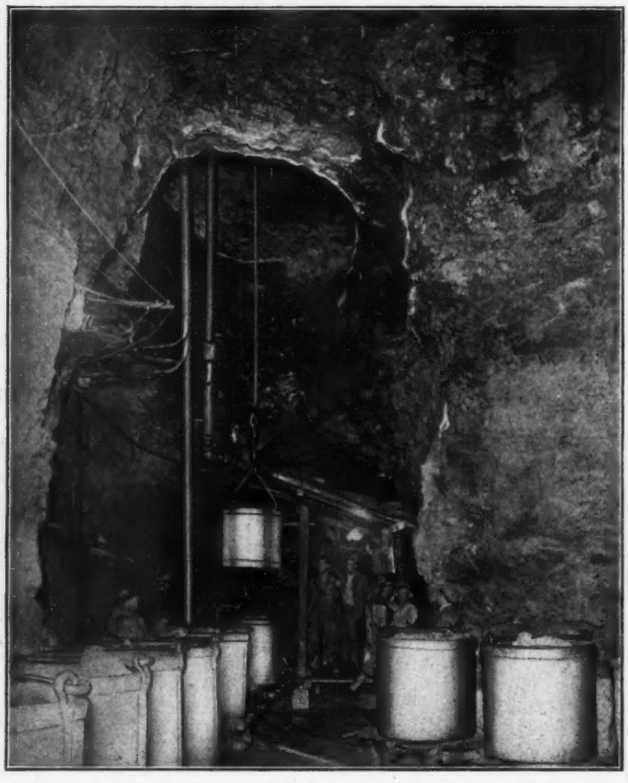


FIG. 2. HOISTING FROM A JOPLIN SHAFT STATION

staked out on the surface 20 ft. or more on a side, the size, grade and depth of orebodies can be closely estimater before putting down a shaft. Previous to the war contractors undertook to prospect a tract for from 75c. to $1 per ft., supplying their own labor, rigs, tools, casing and power. In the fall of 1917 the cost of churn drilling had risen to $1.25 and $1.50 per ft. and over, and concessions in supplies also were required. When a certain number of holes have demonstrated the presence of an orebody, a vertical shaft is started and sunk to ore simultaneously with further drill operations, as illustrated. Shaft sinking costs vary from $25 to $30 per foot.

It has been found in practice that on account of local variations due to the presence of lean or barren portions in the orebodies, the samples from some holes cannot be relied upon. Some holes may pass through good ground without giving evidence of ore in cuttings by striking a lean or barren portion adjacent to high-grade ore. Fissures and vugs or other cavities in the orebody will also often concentrate the heavy sulphides to such an extent that but a small proportion enters the sample bailer, and the results of single holes are therefore often deceptive and consequently not dependable, and drilling data valuable only after a great number of holes have been put down at closely spaced intervals. This method of ascertaining the size and trend of an orebody gives data, also, invaluable as an aid to later mining. Shaft sites may be selected near the center of gravity of the orebody and the lowest point in the trough of the deposit, thus equalizing future tramming distances and obtaining proper drainage grades. Drill holes also assist materially in ventilation where there is but one shaft in a mine and the working face recedes from it to considerable distances.

[1]Development and Underground Mining Practice in the Joplin District, Bull. 129, A. I. M. E.; and Eng. and Min. Journ., Oct. 6, 1917.

Buckets Hoisted Directly to Mill Bins

With but two or three exceptions all the shafts of the district are vertical. Some of the larger companies have two-compartment shafts, but the majority are single compartment. These shafts are not timbered except where cribbed for short distances below the collar in passing through the soft alluvium soil or soft shale caprock in the Miami section. Buckets are used in tramming and hoisting almost altogether, and these are hoisted with ore, supplies or men, without guides and crosshead. Where shafts have two compartments, a

FIG. 3. CUTTING AROUND A PILLAR FROM TWO STOPES

simple plank lining fastened to cross stulls divides each. Over the shaft or each compartment there is a separate hoisting engine, either steam or electric, set in the derrick close enough to the shaft to enable the "hoisterman" to raise and lower without signals by simply looking down and observing the operators.

Shafts in the sheet-ground mines vary in depth from

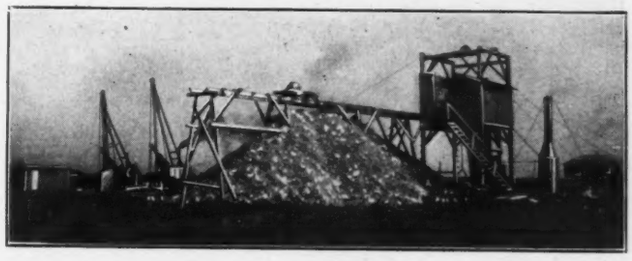
230 to 260 ft. and in the western part of the district from 150 to 250 ft., with but one or two at materially greater depths. The hoisting engine is usually from 50 to 60 ft. above the collar and the hoisting rope passes over a small sheave about 10 ft. higher. The "tubs" or buckets are run to the shaft on trucks by hand or in trains as shown in Fig. 1, according to the size of the mine. The shafts are usually centrally located with respect to the size of the orebody and are sunk for a sump a short distance below the floor of the ore. Stopes are started in two diametrically opposite directions from the shaft for the full height of the orebody, leaving substantial pillars of ore on two sides. A plank platform covering the sump is built, to the level of a bucket truck, and each truck in turn is brought to the edge of this platform prior to affixing the snap or worm hook at the end of the hoisting rope.

A typical shaft station is shown in Fig. 2. The stations are electric lighted and the hoistman can easily observe the hooking and unhooking operations from his position. Empty buckets are lowered on the brakes to the platform, the rope is given the necessary slack and the hook transferred by the "tubhooker"—one at each compartment when there are two—from the loop in the bale of the empty to that of the loaded bucket. At an arm signal from the tubhooker the bucket is slowly raised high enough to clear the empty on the platform, where it is momentarily steadied by him, and then jerked to the surface and level of the hoistman at apparently incredible speed. The tubhooker then rolls the empty on its lower rim to the cleared truck, which is run back to a return track and the next loaded truck is pushed up to the platform. When the loaded bucket arrives at the top, a counterbalanced door operated by the hoistman is dropped across the shaft directly under the suspended bucket, inclining toward the bins, and a swinginig arm hook, offset toward the bins, is brought to engage the ring fastened to the bottom of the bucket. The hoisting rope is then given the proper slack and the bucket dumps its contents backward toward the shaft and onto the incline. The capacity of buckets used in the district is from 800 to 1500 lb., but outside of sinking operations those most in use are 1000 or 1200 pounds.

The No. 3 shaft of the American Davey mine of the American Zinc, Lead and Smelting Co., in Webb City, may be taken as typical of the most efficient hoisting practice in the district. The shaft has two compartments and is 252 ft. deep. Two vertical duplex steam hoists directly driving 24-in. drums wound with ½-in. cables and hoisting 1200-lb. buckets are in use. The average time of one complete cycle of lowering and hoisting is 35 sec. and the average rate of hoisting from both compartments in one eight-hour shift is 1300 buckets, and records have been as high as 1500. Some electric hoisting records are over 2000 buckets per shift.

In his paper Mr. Young gave the cost of hoisting per ton for 1912, 1913, 1915 and 1916, respectively, as 4.68c., 4.33c., 3.99c., and 4.83c., and for four months of 1917 at 6.4c., including power and repairs, which compares favorably with hoisting costs by cages or skips in mines elsewhere hoisting similar tonnages. In the matter of safety, a recent disastrous accident occurred in the Miami district from lowering by means of the brakes a bucket with four men, a risky practice indeed, unless the brakes are frequently inspected. As a matter of fact, however, accidents in Joplin shafts have been remarkably few. Although no bell signal is used in ordinary hoisting operations, there is a bell signal wire in most shafts. In case of accident to the bucket while hoisting ore, the engineer can pull a "skidoo" bell, at the sound of whch everyone at the bottom of the shaft gets away as fast as possible.

From the shaft the orebody is stoped radially in all directions, leaving pillars, as shown in Fig. 3, from 15 to 20 ft. in diameter and 20 to 100 ft. apart, depending upon the character of the ground. In the sheet-ground mines the flint floor and roof are usually quite smooth and level, making an ideal back and floor to break to and obviating the necessity of shoveling plats. Six feet is the minimum height stoped, and the back or height of ore varies up to 25 ft., probably averaging 20 ft. in most sheet-ground mines, but often 30 to 40 ft. or more in the Miami fields. Ore in the sheet-ground deposits is fairly constant throughout the minable areas, and there is little choice of ground when cutting or robbing pillars. In the higher-grade orebodies of the Miami



DRILLING AND SHAFT SINKING NEAR PICHER, OKLA.

district there is this factor of consideration, and although pillars are generally cut entirely with respect to the standing character of the roof, when they are robbed in the final process after all stoping has been carried to the property or natural limits of the orebody, the richer pillars are taken out entirely or in greater proportion than those in the leaner ground. There is, however, in some parts of the sheet-ground mines a "cotton rock" condition of the roof that cannot be supported, which is entirely barren and has to be shot down with the ore, causing at times a certain dilution.

There is no underground sorting in any of the mines, but a small percentage of waste is sorted at the grizzlies over the bins on top. On account of the friability and local variations in grade, underground sampling is impracticable, and estimation of whether certain ground is ore or waste, based on experienced observation, gives satisfactory results. Within the sheet-ground orebodies there are areas where the ore is disseminated rather than laminated, and this ground, being of a brecciated character, does not support the roof so well as the latter, consequently requiring greater pillar diameter and less open stope between. In the sheet-ground mines the flint roof is usually about 40 ft. thick and may be frozen to the limestone above, or separated from it by a thin layer of clay selvage. The first condition exists north of Webb City, where pillars are spaced as far as 100 ft. apart, but in most parts of the district the second condition prevails and 20- to 25-ft. intervals are most common. Sometimes a simple stull and headboard will assist in steadying the back where it is not in a too bad condition and not too high.

There are two methods of breaking ground in practice. In the sheet-ground mines, where the back is frequently under 15 or 16 ft. high, an 8-ft. high heading is driven into the face for a short distance along the floor of the stope and the brow left overhead is drilled from beneath The practice where the back is higher than 16 ft. is to advance the entire height of face progressively from top to bottom in a series of two or three benches or steps. The upper benches are not advanced too far with respect to those below, in order that the ground blasted will clear the edge of the bench below and obviate unnecessary shoveling. In both methods the breast of each bench or heading is carried forward with a serrated face presenting one open side to which the next rounds of holes can break.

Headings are advanced at the width established for the distance between pillars cutting around them until two adjacent headings meet behind the ground so left. The next succeeding row of pillars is then staggered or offset with respect to the first; so that more uniform support is obtained and the minimum amount of space is left standing unsupported. Sufficient provision is made in offsetting to permit the main track lines to be extended to the face without undue deviation from a straight line. In this method of mining from 15 to 20% of the orebody is left in pillars during the stoping stage, but these are robbed in the final process and from 25 to 40% of their tonnage is reclaimed.

Regard to surface conditions must be carefully maintained. Every precaution is taken to insure the surface from a cave. This is necessary on account of the retained surface rights agreed in the terms of the lease. Now and then, however, a cave has occurred, the effect of which is shown in an illustration of the last issue. Many of the sheet-ground mines extend under the residential sections of large communities and paved streets and carlines pass overhead regardless, while dull thuds can be heard and felt underfoot in the streets at shooting time. In the vicinity of Carterville and Webb City the sheet-ground mines have been stoped over single areas underlying 160 acres, and developments indicate that eventually these will have an extent of 350 acres or more.

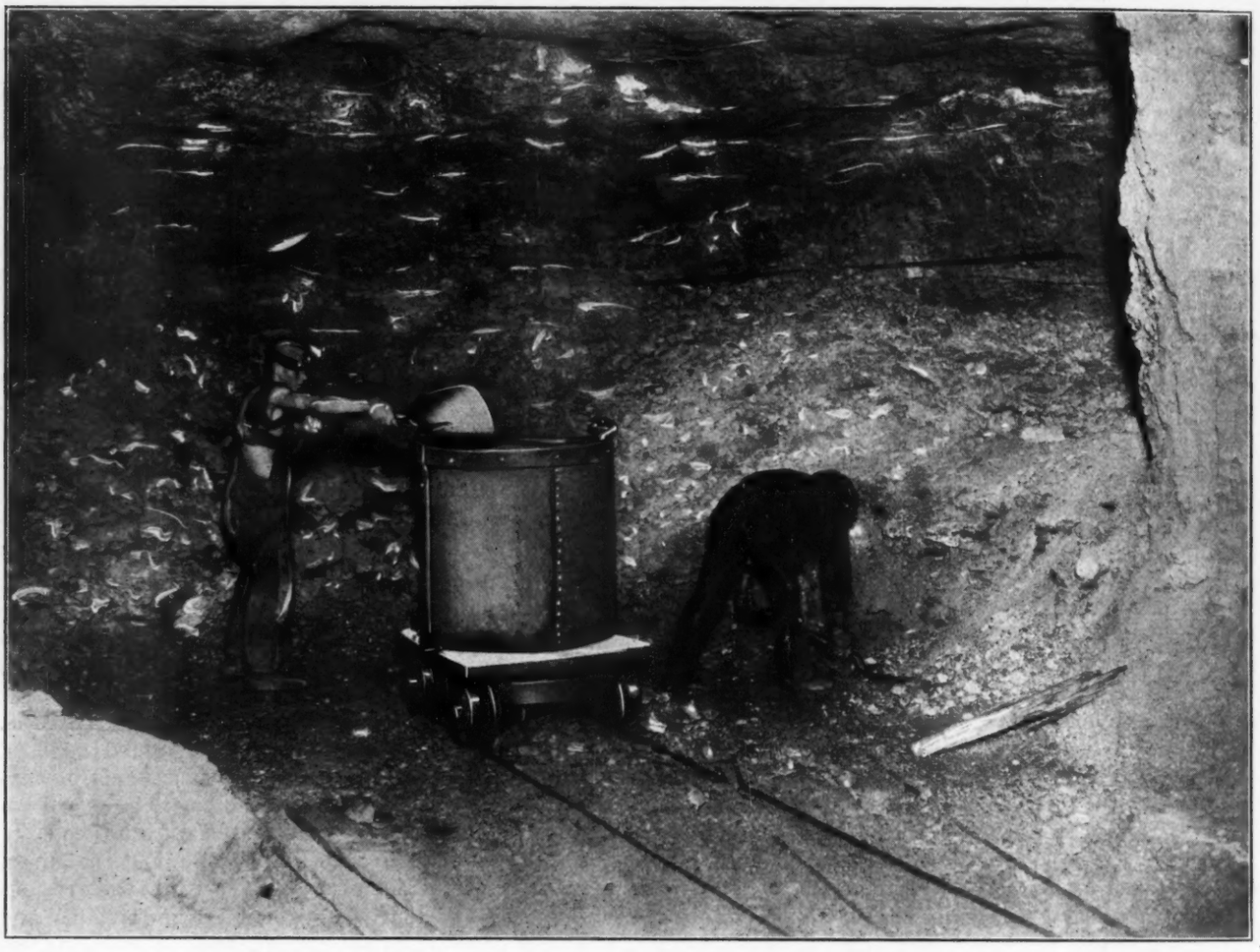


FIG. 4. SHOVELING CREW CLEANING UP A STOPE IN THE JOPLIN DISTRICT.

Throughout the district, in drilling underground two men are customarily used to a machine and Ingersoll-Rand mountable water-type machines have been adopted in most of the mines. Drill helpers act as tool nippers, assist in setting up the machine on the drill column or tripod, either of which is used, depending on the height of the back, and fetch sharp and dull steel between the shaft station or underground drill sharpener and the machine drill. But little dust is created in drilling, owing to the adoption of the water-type hammer drills, and at some of the mines in the sheet-ground district as high as 60 tons per machine shift is broken, as compared to 40 tons when the piston machines were in use.

Large sizes of steel are used and deep holes drilled. Jackhamers are used to break up the larger boulders. Holes are chambered or "squibbed" before final blasting and considerable powder is required per hole. This is especially the case in the Miami section, where the ground is harder to break, although possibly somewhat easier to drill.

In the Miami ground machinemen can drill as much as 90 ft. of hole per machine shift. Air pressure is maintained at 90- and 100-lb. gage. Drilling costs in the sheet-ground mines before the war were under 20c. per ton and blasting costs about 15.5c. per ton. At present these costs range from 25c. to 30c. per ton for drilling and 15c. to 30c. per ton for blasting, according to the ground and whether the powder is obtained under favorable contracts or purchased in the open market. According to the prevailing custom in the district, the drilling is done on day shift and mucking on both day and night shifts. Special crews chamber and load the holes on the second shift, firing as the shift goes off.

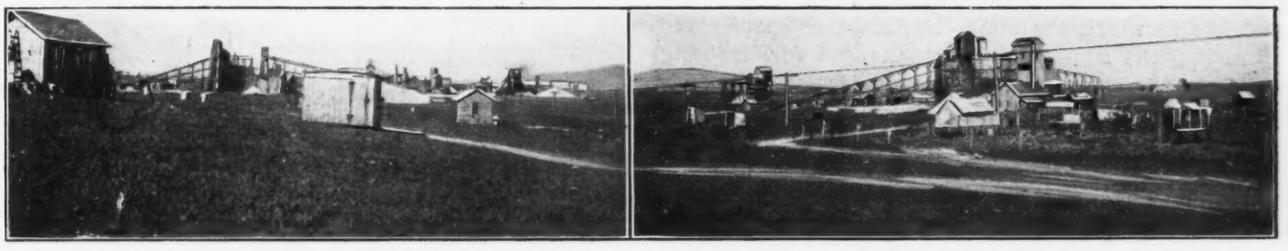
Ventilation in mines connected to more than one shaft is generally good, and the smoke has plenty of time to clear between the night and next day shifts. Air whistles are placed underground at the shaft station in the large sheet-ground mines that can be heard by miners in the remote headings at lunch and "quitting time."

The Joplin district is notable for its shovelers and the large tonnage of mine "dirt," as the ore is called, handled per man. No. 2 scoop shovels are used altogether, and shovelers work in pairs, usually under contract, as shown in Fig. 4. The contract prices are based on a price per "can," according to the bucket tally at the shaft station or motor "lay by" where they leave the loaded trucks, and vary in different parts of the district according to the local wage scale, the height or capacity of the buckets used and the length of tram to the shovelers' "lay by." When labor in the district was abundant and conditions were normal, a shoveler would handle 20 tons per day or more and earned as much as $6 or $7 per shift at a cost of from 20 to 25c. per ton. At present, however, good shovelers are scarce, the efficiency is much lowered, and underground power shovels are again being given consideration at some of the larger properties. Motor, mule, and, where grades are steep, rope-haulage systems are used, depending upon the distances advanced from the hoisting shaft. Shovelers seldom tram their buckets over 200 ft., and where possible these distances are considerably shortened.

The drainage problem in the district, although a factor of considerable moment, is not one offering great difficulties. The gentle grades of levels usually enable the water to be conducted by means of a system of ditches to some central sump at one of the shafts, where steam or electric pumps can handle the flow without much difficulty or undue cost. In the newer mines in the Miami fields, considerable water has to be handled during the early stages of sinking and opening up the ground, but after a time the flow diminishes and the normal quantity necessary to pump at any one station is seldom over 1000 or 1100 gal. per minute. In the sheet-ground mines where adjoining properties are connected underground over considerable distances some workings are forced to drain others, and in such cases central pumping companies have been formed and the cost is distributed on an equitable basis.

In the Picher camp a single drill hole supplies water for the domestic requirements of the population. This hole is 1100 ft. deep and passes through the Netta mine, belonging to the Eagle-Picher Lead Co., a pillar having been left as protection. The mine water in the district is markedly acid and although used in milling throughout the district it is useless for other purposes and has a strong corrosive action on pumps and pipe lines. Centrifugal and triplex pumps are used most commonly.

The wages of the Joplin district are based on a sliding scale that varies with the concentrates market. When concentrates are sold at a basic price from $40 to $45 per ton, machinemen get $2.50 and helpers $2 per day. The wages increase 25% for each increase of $10 per ton in the price of concentrates, and with the market at $75 per ton machinemen receive $3.50 and $3 per day. In the newer fields, where living conditions are less attractive than in Joplin, the wages are higher, and where machinemen, trammers and hoistmen are working on a bonus or contract basis, as they are in some mines, the earnings rise as high as $10 per day in individual cases. As in other parts of the country, cost of mine supplies has increased considerably and the rate of increase for Joplin is shown by the relative pre-war and present prices given in the accompanying table.



DEVELOPMENTS NORTH OF PICHER NEAR THE KANSAS STATE LINE, WITH BENE MUNDE, KAN., IN THE DISTANCE

PRICE OF MINE SUPPLIES IN THE JOPLIN DISTRICT

	1914	1917	Per Cent. Increase
Coal, per ton	$2.10	$3.60	71
Dynamite, 40% pulp, per 100 lb	11.00	18.25	66
40% gelatin, per 100 lb	11.50	20.50	78
80% gelatin, per 100 lb	15.50	31.75	105
Fuse per 6,000 ft	24.75	37.86	53
Caps No. 6 per 1,000	7.57	14.58	92
T-rail, No. 8, per ton	35.00	80.00	129
Drill steel, solid, per lb	.07½	.16	120
Drill steel, hollow, per lb	.10	.23	130
Rubber wire-wound air hose, 1 in., per ft	.25	.35	40

Total underground mining costs per ton as given by Mr. Young for a typical sheet-ground mine hoisting 1000 tons per day are: In 1912, 68c.; in 1913, 65c.; in 1915, 88c.; and in 1916, 99c. In Miami costs are somewhat higher, owing to the inherent conditions to be expected in a comparatively new camp.

Steam-Shovel Ore Cars at New Cornelia, Ajo, Ariz.

The steam-shovel car used by the New Cornelia Copper Co. at Ajo, Ariz., is a logical development of the smaller type originally built for serving steam shovels in railroad work, and the compressed-air features were developed after the two-way side-dump car had outgrown its usefulness.

The improved type of cars were first introduced into the mining field in the Mesabi iron district, 50 being put into use at the Corrigan-McKinney property. Other companies in the district rapidly adopted them, and now they are being used by the Oliver Iron Mining Co., the Biwabik Mining Co., the Great Northern Iron Ore Co., the Republic Iron and Steel Co., the Shenango Furnace Co. and by the contracting firm of A. Guthrie & Co. The cars are also used in surface mining and quarry work by the Michigan Alkali Co. and the Solvay Process Co., and have been introduced in South American development by the Bethlehem Steel Co.

Reference was made to the use of the new-type cars by the New Cornelia Copper Mining Co. in the *Journal* of July 14, 1917. The Utah Copper Co. is also using a large number of these cars. While in the two copper districts in which the above-mentioned companies are operating the equipment has been used for handling ore from the steam-shovel pits, the car is also adaptable to smelter work, and has proved highly suitable for handling fuel or ashes at large power plants, being thus employed by the American Gas and Electric Co., and by the Commonwealth-Edison Co. of Chicago.

The car is of extremely sturdy construction, being all steel and massively built to withstand the excessive strains imposed by use in large rock excavations. This point is of prime importance at Ajo, where individual chunks weighing a ton or more are dropped into the cars from the shovels, which work is similar in character to such excavation as that performed during the extension of the C. & O. Northern, upon which the firm of Langhorne, Langhorne & Sneed cut a roadbed for a considerable distance through solid rock; and work on the Welland Canal, which was in blue gumbo, and in operations now being carried forward by the Norfolk & Western near Roanoke, a solid-rock excavation.

The second highly important feature is the application of air control to the dumping process. Two levers control the unlocking, dumping, uprighting and relocking of one car or any number of connected cars. From 20 to 30 seconds' time is ample for one complete cycle of operations.

In controlling a train unit, a single unskilled operator, by the manipulation of one lever, can unlock and discharge 300 cu.yd. of material within 10 seconds, and can upright the entire train, relock, and have it started on the return trip within another 10 to 15 seconds. The operator can either dump the entire train to the left or to the right or dump alternate cars right and left; and he can dump any selected car singly from a position on any car in the connected train. When dumping a connected unit, all cars can be dumped simultaneously—a point of time economy and also a point of considerable importance when it is desired to spread the load by dumping while the train is in motion. Cars are operated by air drawn from the regular air-brake train line,

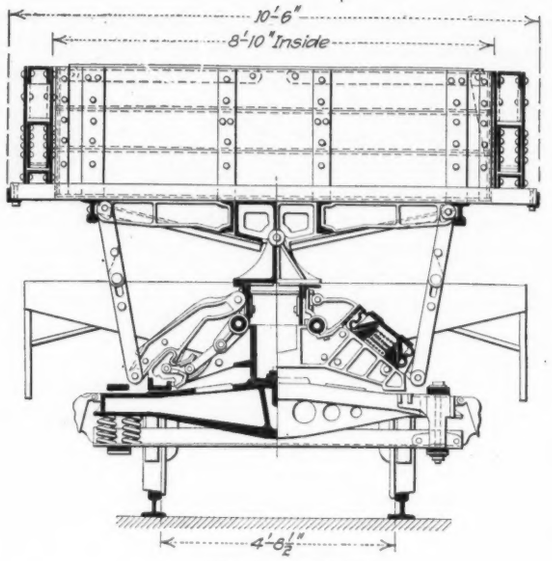


FIG. 1, SECTION

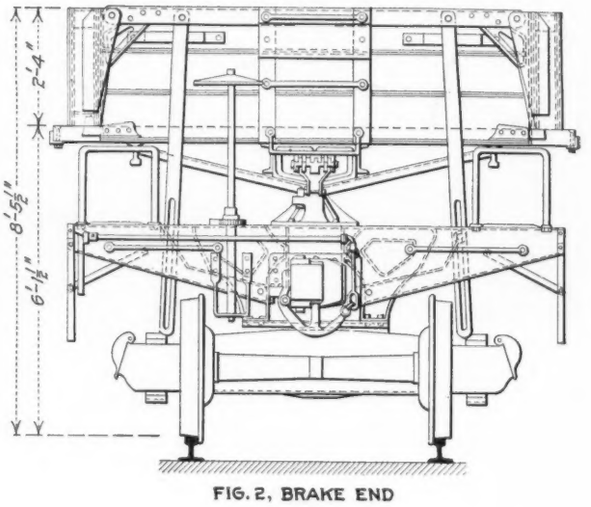


FIG. 2, BRAKE END

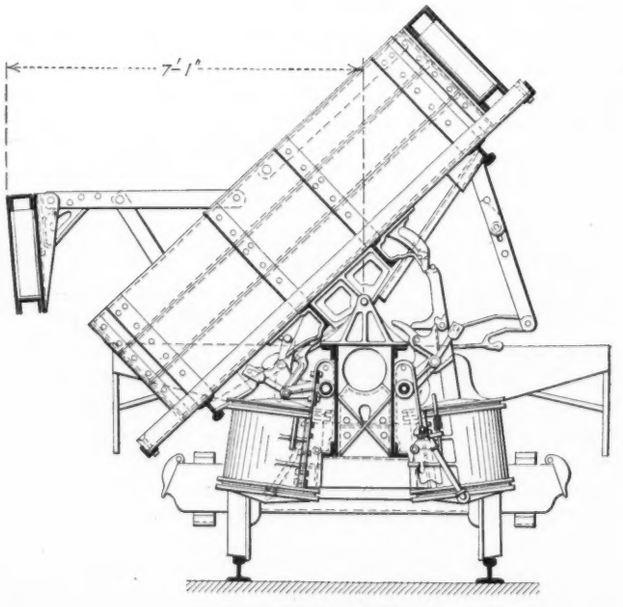


FIG. 3, SECTION

DETAILS OF BRAKE END AND MID SECTIONS OF THE AIR-CONTROLLED SIDE-DUMP STEAM-SHOVEL CARS.

and the air is stored in reservoirs on each car to be drawn upon when dumping, as shown in Fig. 3. It is quite practicable, therefore, to dump a loaded train after the engine has been disconnected.

Other points of the car of considerable importance in certain mining work are the car-floor extensions, which with the sharp dumping angle cause the load to be thrown a considerable distance from the rail and from the free-swinging door, the action of which tends to obviate any possibility of danger from overturning when the door is struck in dumping.

The car, as shown in the illustrations (the R-20 type made by the Kilbourne & Jacobs Manufacturing Co., of Columbus, Ohio), has a 20-cu.yd. (80,000 lb.) capacity, with a maximum load capacity of 100,000 lb., and is equipped with automatic two-way air-dumping devices. The weight of the body is 34,200 lb. and of the trucks 13,800 lb. and a $\frac{5}{16}$-in. steel floor-plate covering the entire bottom of the car brings the total weight to 51,700 lb. The cars are built for a standard-gage track and are equipped with Westinghouse schedule K. D. 1012 airbrakes. The dumping device consists of air cylinders made of machine quality cast iron 20 in. in diameter, one on each side of the car, as shown in Fig. 3. The operation is controlled by two three-way valves at one end of the car and the air is automatically cut off when sufficient pressure in the cylinder will dump the car.

A locking device is placed on both sides of the center line of the car and is controlled by direct connection to the air piston. The car is held in an upright position by sixteen $\frac{3}{4}$ x $3\frac{1}{2}$-in. steel locking bars shown in Fig. 1. At the top these bars are connected to the body underframe by special cast-steel bearings and to the underframe braces by means of cold-rolled steel pins. At the bottom the bars are fastened to a steel arm, which is held in position by the body bolsters. These members are of scissor-type construction and fold under the bed on the dumped side of the car during the dumping operation. The angle of dump is 45°. The locks consist of a steel arm and knuckle placed in the body bolster and are entirely automatic. They are operated by a shaft running between the body bolsters, secured in babbitted boxes, and operated by the main dumping cylinders.

What Is Labor Unrest?*

The human mind is the most complex piece of mechanism in the world. It is the master mechanism. How it works nobody knows. What it will do individually and collectively under any given conditions, nobody knows—not even its owner.

The man who digs your ditches has depths you cannot plumb. You see him come and go every day, and his coming and going become a part of your daily habit of thought, like the coming of your morning newspaper. Some day he doesn't blend with the scenery as you are accustomed to viewing it. Unknown to you there has been some crisis in his life; his mental depths are in turmoil; age-old questions come to the surface. Placidity becomes turbulence, and you are annoyed—unless you have become similarly turbulent yourself, in which event you are not annoyed. You understand.

Your ditch digger has thousands of years of his ancestors' life and thoughts and yearnings slumbering in his soul and speaking when he is roused. He has not always been a ditch digger. Some centuries past in Asia Minor, in Greece, in Italy, along the whole line of civilization's push upward, he has been oppressor and oppressed, just as you have been—mostly oppressed, for the oppressed have always been in the majority.

One life begins and ends; but the blood-flow is continuous from generation to generation. The thousands of years behind us speak in us and to us and through us every day. The greatest thinkers, ancient and modern, affirm this.

There has been more stirring of the human depths since August, 1914, than there had been in the whole period since our Civil War. All of our accustomed grooves have been upset. In our social bearings we lack a sureness of direction. The guide posts have become weather vanes. Our placid gray matter has been set seething. The former smooth surface of our minds, which reflected the current weather, the passing clouds and the orderly seasons, is turbulent; the sediment of the centuries is bubbling to the surface from the depths.

We get into channels. Channels are comfortable. They fix direction. Where you are going doesn't worry you. It suffices that you are comfortably on your way. Then something happens and destroys the channel. You and your ditch digger face each other with the eternal question of your mutual relationship in your eyes. The thousands of years back of each of you are compacted in the look. *And you couldn't phrase the question in words if you tried.* You don't try, either of you. Instinctively you know it, but to save your souls neither of you could say it.

If you tried to say it, you would both use the words you used in the channel—wages, open shop, cost of living. Especially the ditch digger would. He couldn't phrase the concentrated protest of ten thousand years in a moment of crisis any more than he could think it logically in a year in the channel. It is too big, too overwhelming, too much a rising of his whole being.

So when you ask him what he is turbulent about, don't quibble about the lack of a clear-cut answer. It can't be made; you couldn't make it yourself. But if you want his answer, get it in his reactions. Hear him give approval to war against the Kaiser; note the set of his features when the war profiteer is mentioned; watch him as he listens by the hour to the man you would call an agitator; catch his constant sanction to the opportunities open alike to everybody and his equally constant suspicion of opportunities not possible for *his* children. The public schools are never afraid to go direct to the people for money; universities are.

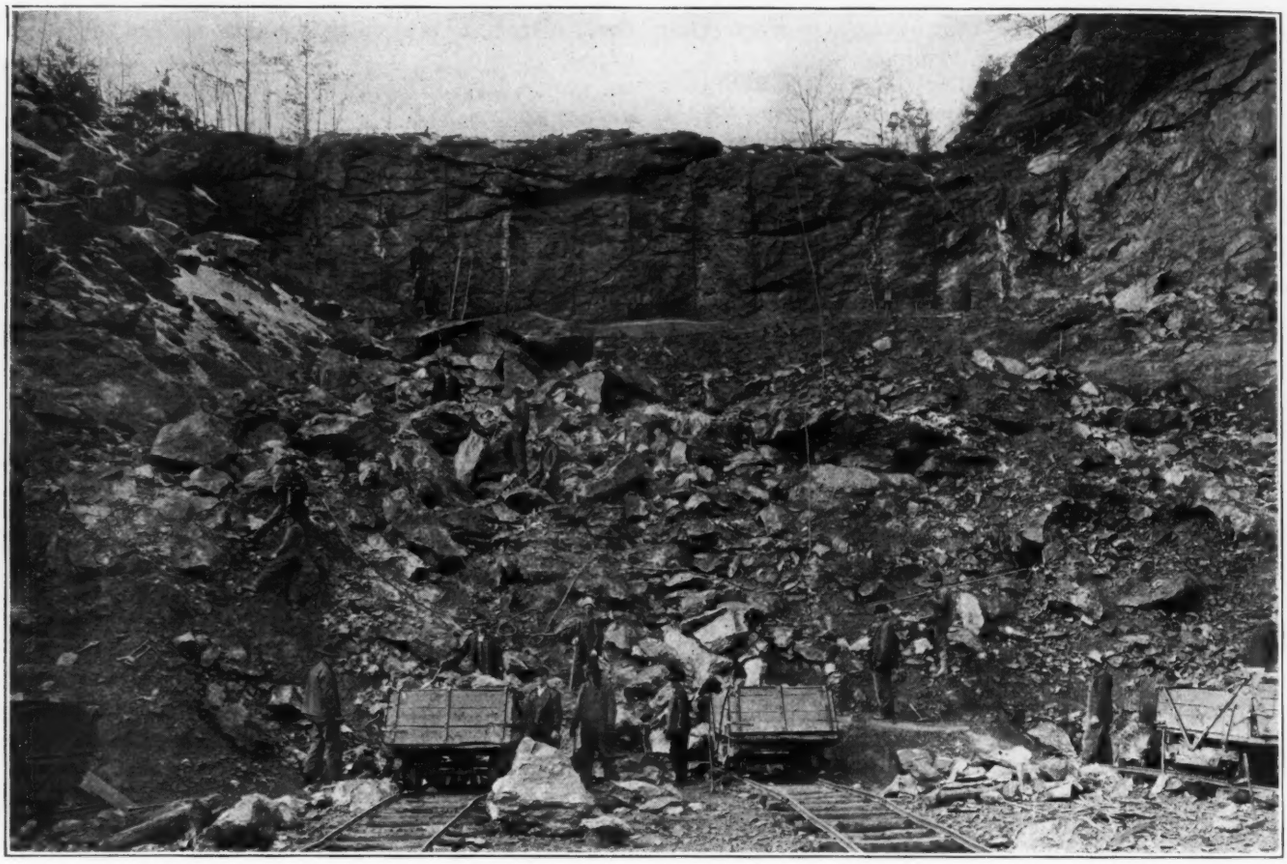
Business based on the idea of maximum cash returns to the owner, at any cost to competitors, to labor, to the social order, to the Government, was bound to be a boomerang.

The labor unrest is the instinctive protest of ten thousand years against all this.

*An editorial in *Engineering News-Record* of Feb. 21.

Mining Titles in Mexico to the number of 320 were issued during the last six months of 1917 by the Mexican government. The State of Sonora led, with 117. Nuevo Leon, Chihuahua, and Durango were the other states showing a large number of denouncements.

Pyrrhotite Open-Cut Mines of Virginia



BREAST OF PYRRHOTITE ORE AT BUMBARGER MINE, NEAR MONARAT, VA.

BUMBARGER PYRRHOTITE MINE OF THE GENERAL CHEMICAL CO., AT MONARAT, VA., NEAR THE

OPEN-CUT WORKINGS AT BUMBARGER MINE OF GENERAL CHEMICAL CO., MONARAT, VA.

OPEN-CUT 200 FT. DEEP, SHOWING ORE IN PLACE, AT HUEY MINE, NEAR MONARAT, VA.

CHESTNUT YARDS OF THE NORTH CAROLINA EXTENSION OF THE NORFOLK & WESTERN RY.

Chrome-Ore Specifications and Producers of Chromite in California

The importance of chromite as a war mineral has resulted in vigorous prospecting for, and the opening up of, mineral properties. The chromite market imposes certain specifications that sellers of chrome ores must comply with before they can dispose of their ore. A list of producers of chrome ore in California and a description of the largest Pacific Coast deposit of chromite are given.

SPECIFICATIONS for chrome ore as used by some of the large consumers in different industries are reported by the California State Mining Bureau in a recent bulletin.[1]

The purest ores are required for the chemical and ferroalloy industries. For the manufacture of chromates, ores with a minimum of 50% Cr_2O_3 are desired, although the Mutual Chemical Co. of America, 55 John St., New York, states that it will accept ores containing a minimum of 48% chromic oxide and a maximum of 6% silica. The Sawyer Tanning Co., Napa, Calif., uses chromite in the production of bichromate of soda for its plant at Napa, but "can use chromite only when containing 47% or more of chromic oxide and not over 8% of silica."

Ore 50 Cr_2O_3 for Ferroalloys in Demand

Metallurgical ore for ferroalloys should also preferably contain 50% or more of chromic oxide and small amounts of sulphur, phosphorus and similar impurities. The Goldschmidt Thermit Co., 120 Broadway, New York, in making a 60% carbon-free ferrochromium, "prefers the ore to be over 50% Cr_2O_3, less than 1½% SiO_2, only traces of sulphur and phosphorus and no injurious metals." This company prefers a contract "covering all possible points between buyer and seller, such as specifications, delivery, quantities, etc., and to pay 100% on the dry weight after weighing, sampling and analysis by a third independent party, whose results shall be final." The Noble Electric Steel Co., 995 Market St., San Francisco, Calif., specifies an ore containing 30% metallic chromium and not over 10% silica, and will not enter into an unbonded contract nor without first inspecting the chrome property and making sure that there is some probability of the producers making good on their contracts. Foote Mineral Co., dealers, 107 North 19th St., Philadelphia, give the following specifications for metallurgical ore: Cr_2O_3, minimum, 40%; SiO_2, maximum, 5%; S, maximum, 0.5%; P, maximum, 0.2 per cent.

Specifications of brick makers vary considerably, but are generally lower than those of the ferroalloy or chemical plants. The St. Louis Refractories Co., Title Guaranty Bldg., St. Louis, Mo., under date of Aug. 4, 1917, stated that it intended to make some chrome brick, but did not at that time have its plant arranged for it; as a dealer, however, it was prepared to purchase about 1000 tons of 34% to 40% ore. The American Refractories Co., Joliet, Ill., desired ore containing from 40% to 50% Cr_2O_3, a minimum of 15% Fe_2O_3 and of 8% SiO_2. The company prefers specified tonnage contracts; usual terms, 80% sight draft against bill of lading; balance payable on delivery of car, sampling and analysis at destination; when seller has shipment sampled and analyzed by reputable chemist, company will pay sight draft for full value, based on such analysis. The Harbison-Walker Refractories Co., Farmers Bank Bldg., Pittsburgh, Penn., specified: Cr_2O_3, minimum, 40%; SiO_2, maximum, 6%; Fe_2O_3, maximum, 15%. Usual form of contract provides for 80% sight draft, with bill of lading and certificate of analysis attached; balance on determination of quality of ore after arrival.

Producing Chrome Properties in California

Owners and operators of producing chrome deposits in California are listed by the California State Mining Bureau as follows:

Agard & Stewart, 268 Market St., San Francisco, Calif.
Alexander, F. A., 225 Monadnock Building, San Francisco, Calif.
American Exploration Co. (lease of Tyson Mining Co.), Grants Pass, Ore.
Austin, H. C., Georgetown, Eldorado County, Calif.
Biggs, H. C., 2718 California St., San Francisco, Calif.
Bingham, Alonzo, Callahan, Siskiyou County, Calif.
Brewer, Florence & Dennis, A. S. (property in Trinity County leased to Federal Chrome Co.), Red Bluff, Tehama County, Calif.
Bunker, H. H., Michigan Bluff, Placer County, Calif.
Calhoun, Frank, Locating Co., 200 Phelan Building, San Francisco, Calif.
Carson, Frank, Visalia, Tulare County, Calif.
Chaix, S., Latrobe, Eldorado County, Calif.
Clary, Harry, Angels Camp, Calaveras County, Calif.
Crisle-Riffe Chrome Mine, Kings River, via Sanger, Fresno County, Calif.
Curran, W. E., Sanger, Fresno County, Calif.
Davis, John, Copperopolis, Calaveras County, Calif.
Dibblee & Arata, San Luis Obispo, Calif.
Dolbear, S. H. (for American Refractories Co.), 1411 Merchants National Bank Building, San Francisco, Calif.
Dougherty, C. F., Strathmore, Calif.
Driesbach, F. M., 2101 E. 12th St., Oakland, Calif.
Farish Co., Inc., Insurance Exchange Bldg., San Francisco, Calif.
Farmer, R. H. (Placer Chrome Co.), Newcastle, Placer County, Calif.
Fenster, G. C., & Lehow, W. S. (leased to C. H. Holbrook, W. L. McGuire and H. E. Springer), Crocker Building, San Francisco, Calif.
Fuqua, T. F., & Bell, R. E., Lower Lake, Lake County, Calif.
Graham, W. S., Ukiah, Mendocino County Calif.
Gravlin Chrome Mine, Grants Pass, Ore.
Green, W. C., Georgetown, Eldorado County, Calif.
Healdsburg Mineral Co., Healdsburg, Sonoma County, Calif.
Hill, S. W., Red Bluff, Tehama County, Calif.
Hollister, William, San Luis Obispo, Calif.
Hothersall, George J., Nevada City, Calif.
Joerger, Martha, Oakland, Alameda County, Calif.
Johnson, G. S., & Co., Phelan Building, San Francisco, Calif.
Kleinsorge, W. E., 605 Peoples Bank Building, Sacramento, Calif.
Lambert, N., Magalia, Butte County, Calif.
Levensaler-Speir, Monadnock Building, San Francisco, Calif.
Mackey, Peter, Jamestown, Tuolumne County, Calif.
Madrid, John, Angels Camp, Calaveras County. Calif.
Maltby, C. S., 1311 Humboldt Bank Building, San Francisco, Calif.
Marianno, J. F., Box 6, Chinese, Tuolumne County, Calif.
Masterson, T. F. & A. C., Callahan, Siskiyou County, Calif.
McFaul, J., Angels Camp, Calaveras County, Calif.
Meyer, Fred, Weimar, Placer County, Calif.

[1]Preliminary Report No. 3, "Manganese and Chromium," California State Mining Bureau, San Francisco, Calif.

Mineral Products Co., 334 Rialto Building, San Francisco, Calif.
Mineral Resource Co. of America (care of Ralph E. Hyatt), Hughes Hotel, Fresno, Calif.
Neill, Thomas, Pope Valley, Napa County, Calif.
Newman Chrome Mine, Livermore, Alameda County, Calif.
Nichelini, A., Chiles, Napa County, Calif.
Neilson, G. W., & Donnelly, P., Folsom, Sacramento County, Calif.
Noble Electric Steel Co., 995 Market St., San Francisco, Calif.
Norcross, D. C., 430 California St., San Francisco, Calif.
O'Brien, James, Hoff, Peter, & Ybright, Charles, Latrobe, Calif.
Peri, Frank, Copperopolis, Calaveras County, Calif.
Pierce & Benadom, Morro, San Luis Obispo County, Calif.
Pilliken, George, Folsom, Sacramento County, Calif.
Power Timber Co., Call Building, San Francisco, Calif.
Rhodes, L. H., Gribble, C. N., & Byle, B. J., Coalinga, Calif.
Richards, George A. & Thomas, Oakdale, Calif.
Roeper, J. C., Independence, Inyo County, Calif.
Ryan, Thomas, Copperopolis, Calaveras County, Calif.
Sanger Mining Co., Sanger, Fresno County, Calif.
Solinsky, F. J., 729 New Call Building, San Francisco, Calif.
Sullivan, D. J., Hemphill, W. F., & Noble, R. E., Dutch Flat, Calif.
Tedoc Mining Co. (lease of Charles Carpey and James Brown), 268 Market St., San Francisco, Calif.
Trinidad Mining Co., 214 Front St., San Francisco, Calif.
Tucker, Henry (leases of Newhall Estate), Calistoga, Napa County, Calif.
Turner, R. Chester, Grass Valley, Nevada County, Calif.
Turner, R. L., & Geisendorfer, C. A., Colfax, Placer County, Calif.
Tyson Mining Co., Tyson Building, Baltimore, Md.
Union Chrome Co., Adams Building, 180 Sutter St., San Francisco, Calif.
Wait, A. L., Plymouth, Amador County, Calif.
Walsh, Guy & Hall, Auburn, Placer County, Calif.
Ward, George, Fosteria, Calaveras County, Calif.
Waters, Charles, San Luis Obispo, Calif.
Wellman, Scott I., 3603 Finley Ave., Los Angeles, Calif.
Wheeler, A. A., 1640 Clay St., San Francisco, Calif.
Williamson Bros. & Cole, Washington, Nevada County, Calif.
Williamson, O. S., & Beck, C., Iowa Hill, Placer County, Calif.
Wilson, Fred, Angels Camp, Calaveras County, Calif.

The California bulletin also gives a list of about 70 chrome properties that have had some development and a further list of about 40 undeveloped properties.

Largest Chrome Mine of the Pacific Coast

The largest known body of chromite on the Pacific Coast was in Shasta County in what was formerly called the Brown mine,[1] on the south slope of Little Castle Creek, three miles south of Dunsmuir. This mine was acquired by the California Chrome Co. in 1915, and the engineer in charge, J. R. Van Fleet, furnished the U. S. Geological Survey with the accompanying notes concerning this great orebody:

"On the first level of the mine, the orebody is 146 ft. long in a direction N 40° E and 40 ft. wide, with a height of 54 ft. On the second level, 30 ft. below, the length increased to nearly 160 ft., but the orebody decreased by half in width and thickness.

"The country rock of the chromite orebody is in part peridotite, but chiefly pyroxenite, which exhibits large cleavage surfaces, often several feet in extent. These cleavage surfaces are sometimes spotted with grains of olivine, giving the surface a decidedly greenish color. Along the east wall the pyroxenite has been altered into serpentine, which gradually merges into the parent rock in a few feet. On the south end of the orebody there was a mass of heavy black rock, probably dunite, which to the uninitiated was easily mistaken for chromite. Along the east wall there was a decided line of cleavage between the ore and the wall, the ore coming away free and clean; while on the west side there was no line of demarcation, the ore grading off into the wall rock and often large masses of the wall rock intruding into the orebody. This same occurrence also existed on the top 10 ft. of the south end.

"The orebody was characterized by numerous seams throughout. These seams were filled with a clay gouge containing fine particles of chromite and olivine, were from the thickness of a knife blade to several inches in width, and the surfaces of the chromite adjacent were smooth, but showed no striations due to faulting. These seams exhibited no apparent system, except that they were generally wedge shaped, always with the large end down, making the ore exceedingly heavy and hard to hold with timbers. There was one well-defined fault, which penetrated the orebody about through its center of mass in a northwesterly direction, and, like the orebody, dipped to the northeast about 75°. The position of this fault is shown at both levels on the plan of the deposit submitted. No evidence of any vertical throw was found, but there was a transverse or horizontal throw of about 5 ft. on the first level. On the second level there was no throw observed. Along this fault plane there was a zone of about 4 ft. in thickness of muddy clay containing fragments of chromite from fine particles to several hundred pounds in size. The walls of the adjacent chromite were smooth."

In view of the early production of the deposit, this orebody has been estimated as containing 12,000 tons of merchantable ore. There was a shrinkage in washing and grading of about one-third, so that the contents within the limits of the orebody approximated 18,000 tons. Concerning other deposits, Mr. Van Fleet says:

"It has been my experience that the chromic-oxide content of ore in a deposit varies considerably. Almost invariably I have found the outcrop and float of smaller deposits to be the best material. In one case, near Callahan, in Siskiyou County, this occurrence was so marked that the lower portions of the deposit were not of marketable quality. Also, in the smaller deposits, when there is a well-defined cleavage between the inclosing rock and the chromite on all sides, the ore throughout is of about the same grade. Where there is a hard rib or zone in the deposit, the hard rib of ore is of higher grade than that surrounding it. Of course, this would hold only when the hardness is not due to an impurity. This occurrence was particularly marked in the Little Castle Creek deposit. Where there is no line of cleavage between the ore and the wall rock, there are apt to be intrusions of the surrounding rock into the orebody. The grade of the ore decreases near these intrusions."

[1]U. S. Geol. Surv. Mineral Resources, 1914, Part I, p. 10, 1916.

Deposits of High-Grade Iron Ores found in the Biscayan Provinces of Spain, according to *Commerce Reports*, are easily mined, close to tidewater, and handled with cheap labor. These deposits have been immensely profitable, with the result that Bilbao, which is the center of the industry, is reputed to be the wealthiest city of its size in Europe. The deposits are distributed by provinces as follows: Producing—Guipuzcoa, 92 acres; Vizcaya, 2184; Santander, 709; total, 2985 acres; nonproducing—Alava, 1525 acres; Burgos, 3248; Guipuzcoa, 7594; Vizcaya, 13,163; Santander, 13,483; total, 39,013 acres.

Flotation of Chalcopyrite in Chalcopyrite-Pyrrhotite Ores of Southern Oregon*

BY WILL H. COGHILL†

The chalcopyrite is intimately mixed with the gangue sulphides, and ore must be ground to about 200 mesh. With one ore, calculated recovery is 78.7% of the copper, with concentration ratio of 12:1, the concentrates carrying 27.4% copper. Other approximations of results show up to 90% extraction. Gold, about $2 per ton in ore, goes largely into tailings, but can be amalgamated.

IN 1916 the U. S. Bureau of Mines entered into a cooperative agreement with the Oregon Bureau of Mines and Geology for the purpose of investigating problems bearing on the treatment of low-grade and complex ores. I was placed in charge of these investigations as consulting metallurgist, and laboratory room for the necessary tests and experiments was provided at the Oregon Agricultural College, at Corvallis. One of the first problems taken up was the possibility of separating chalcopyrite from pyrrhotite and pyrite by flotation.

Chalcopyrite is the copper-bearing mineral found at many places in southern Oregon; often it is intimately associated with pyrrhotite and pyrite. In places these two gangue minerals form as much as 75% of the ore, so that the vein consists almost wholly of sulphides. Ordinary gravitation methods of concentrating the copper-bearing mineral cannot be applied, because the gangue sulphides have practically the same density as chalcopyrite. Magnetic separation does not seem practicable—assuming that the gangue sulphides, either in a natural state or after a preliminary treatment, can be made to respond to an electromagnet—because fine-grinding is required to liberate the mineral grains. The methods of concentration now employed are hand sorting and jigging, which eliminate some of the siliceous gangue. Inspection of the smelter returns in the possession of mine operators shows that the average grade of ore shipped runs 10% in copper.

The experimental work on separating the chalcopyrite from the gangue by flotation has been carried through the preliminary laboratory stage with encouraging results. As a mill may never be considered complete and finished until the orebody is exhausted, so in this, as in other ore-testing experiments, there are still undetermined factors. However, in order that those who are interested in the separation of sulphides by flotation may have the results of the laboratory work before them, this preliminary report is to be published by the Bureau of Mines.

TESTS AND GENERAL DISCUSSION

The tabulated data in Table I record progress tests—those in which the results obtained approximate successful practice. Many random tests also were made to find the nature of disturbing influences and how to meet them, but only a few of these are enumerated.

TABLE I. RESULTS OF PROGRESS TESTS ON FLOTATION OF CHALCOPYRITE-PYRRHOTITE ORES OF SOUTHERN OREGON

(Samples used weighed 1 to 16 lb. and carried 1.13% to 3.2% copper; ratio of concentration from 8:1 to 12:1. All the samples were fresh and unoxidized except Nos. 16, 17 and 18. These three contained some malachite and azurite, which accounts for the tailings being of higher grade than the average.)

No. of Test	Name of Mine	Through 200 Mesh, %	Copper in Tailings, %	Copper in Tailings, % of Total Cu
1	Waldo	54.0	0.45	7.2
2	Waldo	74.6	0.70	20.7
3	Waldo	94.0	0.30	6.1
4	Waldo	92.0	0.50	13.0
5	Morrison	44.0	0.12	6.3
6	Morrison	97.7	0.12	5.0
7	Rowley	82.0	0.25	8.6
8	Rowley	82.2	0.20	6.2
9	Queen of Bronze	64.5	0.55	....
10	Queen of Bronze	....	0.30	23.4
11	Queen of Bronze	....	0.26	16.7
12	Queen of Bronze	....	0.23	8.1
13	Queen of Bronze	95.5	0.55	24.5
14	Queen of Bronze	94.5	0.50	20.3
15	Queen of Bronze	91.4	0.35	15.1
16	Queen of Bronze	92.0	0.90	29.2
17	Queen of Bronze	77.5	0.70	16.6
18	Queen of Bronze	99.0	0.60	16.1

Several of the progress tests were made to conform to the tentative flow sheet shown in the accompanying diagram. The results of one test made in coöperation with D. C. Morris, representing the American Exploration Co., of Grants Pass, are given in Table II. This sample was crushed excessively fine. It is likely that a fineness of 75% through 200 mesh would have been satisfactory. Callow cells were used, but the Minerals Separation type of machines seemed to give equally good results.

TABLE II. PRODUCTS OF FLOTATION TEST OF QUEEN OF BRONZE ORE

(Feed assayed 3% copper; sample crushed to 99% through 200 mesh; contained oxidized copper.)

No. of Test	Products	Weight of Product., Grams	Per Cent. of Total Weight	Copper in Product., %	Grams of Copper 100-gram Basis	Per Cent. of Total Copper
54	Concentrates	450	6.0	28.3	1.70	58.5
63	Tailings from middlings cell	925	12.3	3.3	0.41	14.1
65	Tailings from cleaner	227	3.0	11.0	0.33	11.3
61	Tailings	5,940	78.7	0.6	0.47	16.1
	Totals	7,542(a)	100.0	....	2.91	100.0

(a) 7,542 grams = 16.63 lb.

As the work was done with the intermittent type of machines, there were, necessarily, middlings products—63 and 65 in Table II—that have to be disposed of by approximation, in calculating the results, as shown below. From Table II the milled products, on a 100-gram basis, appear to be about as follows:

Percentage of Recovery—Nos. 63 and 65 containing 12.3 + 3.0 = 15.3 grams of pulp would produce tailings running 1% copper. Then 15.3 × 0.01 = 0.15 gram copper lost. This loss, added to that from No. 61, shows a total of 6.15 + 0.47 = 0.62 gram copper lost, or 0.62 ÷ 2.91 = 21.3% of the total copper is lost. Hence the recovery is 78.7 per cent.

Ratio of Concentration—These two middling products contain 0.41 + 0.33 = 0.74 gram copper. The loss in reconcentrating is 0.15 gram. The recovery from them is therefore 0.74 — 0.15 = 0.59 gram copper. Assuming that this 0.59 gram of copper is in concentrates running 25% copper, there would be 0.59 × 4 = 2.36 grams of concentrates. The total concentrates would then amount to 6.0 (No. 54) + 2.36 = 8.36 grams concentrates. This means a final concentration of 100 into 8.36, or a ratio of 12:1.

Grade of Concentrates—In 8.36 grams of concentrates there were 1.70 + 0.59 = 2.29 grams of copper; 2.29 ÷ 8.36 = 27.4% copper in concentrates.

This method of approximation, applied to the tests from samples 1 to 15, inclusive (Table I), produces an extraction of 90% with equally high-grade concentrates, except where, as shown by grab samples of the overflow,

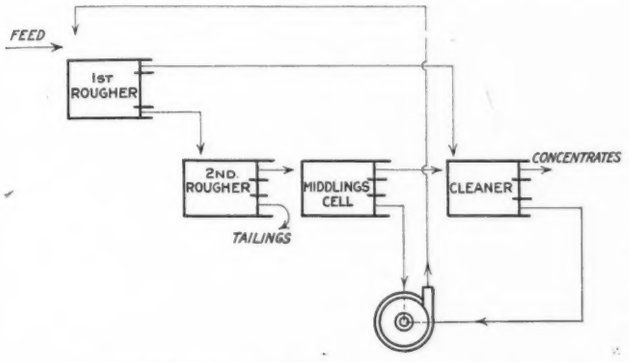
*Advance publication of Technical Paper 182, U. S. Bureau of Mines; by permission of the Director.

†Consulting metallurgist.

the test was stopped too soon. It should be noted in regard to the test shown in Table II that only 15.3% of the charge entered the closed circuit for retreatment. This quantity, although small when compared with average practice, is excessive for these ores; it was large in these tests because they were prolonged in the effort to float the oxidized copper. The freedom with which the fresh chalcopyrite floats is remarkable. At times there is also apparent a most striking play of brassy colors on the overflow.

Color Not a True Indicator of Grade of Froth

This reference to color introduces a fertile subject for scientific discussion, but can be treated only briefly here. The first impression was that the color was a true indicator of the grade of the froth, but later work showed that it was not. Sometimes the Minerals Separation type of machine gave a richer looking froth than the Callow type, when analysis showed it to be of lower grade. When the pulps are of equal densities, the Minerals Separation machine gives, without fail, a brassier



TENTATIVE FLOW SHEET FOR CHALCOPYRITE-PYRRHOTITE ORES OF SOUTHERN OREGON

froth than the Callow. This seems natural because the Minerals Separation machine makes less froth where the bubbles have had more opportunity to gather the chalcopyrite. The burden of chalcopyrite is, therefore, heavier and more evident than in a Callow machine, where the great number of bubbles—some of them doubtless barren—dart to the surface and form a voluminous froth. The heavy burden of non-wetted mineral carried by the froth stabilizes it by the "skew-back" effect discussed in a recent paper.[1]

The Callow froth showed a better color on the concave (upward) surface than on the convex, that is, in the depressions. Although it is true that the weight of the mineral grains should be considered as a factor in causing them to slip down the surface to the lowest point and thus increasing the burden there, it should be noted that the resultant of the molecular forces points in that direction. The fact that the resultant points toward the depression can be emphasized by the following analogy; the physical principles will be discussed at another time: Float a mineral grain in a drinking glass that is thoroughly cleansed so that the water turns up to meet the glass. The mineral will seek the lowest part of the meniscus—the center. Fill the glass to overflowing so that the liquid surface becomes convex, and the mineral again travels to the depression—this time at the circumference. When floatability is due to the surface-tension film, the floating substance invariably seeks the lowest point on the meniscus.

The ores assay about $2 a ton in gold. Hand sorting and assaying a Queen of Bronze sample revealed that about 95% of this gold is in the chalcopyrite. Unfortunately the flotation concentrates contain only a small proportion of gold. It is likely that the gold is embedded in the cleavage planes of the chalcopyrite and is released on crushing. The gold in the tailings amalgamated freely in bottle-amalgamation tests, proving it to be in the metallic state.

Oil Used Gave Steep Surface-Tension Curve

Only one oil[2] was tried. It was selected from a stock of 22 oils on account of its desirable physical properties. The surface-tension effect of these oils had been determined and plotted by E. H. Miller, of the U. S. Bureau of Mines, and the one used was found to give a steeper surface-tension curve than any other oil in stock. It was selected because a froth with a slightly variable surface tension would, with the solids present, be sufficiently stable. Whether the other oils would have proved satisfactory was not determined, as the oil mentioned gave excellent results. Its miscibility is an important characteristic.

Only once, and then by accident, was the ore ground in the presence of an insoluble oil. The insoluble oil acted as a collector on all the sulphides present and spoiled the differential separation sought. The overflow carried only 5% copper, whereas 30% copper in the first overflow was to be expected when the pulp carries 2½%. As already stated, the oil used reduces surface tension. It seems strange, in view of all that has been written on the subject, that there are no published data on absolute values of surface tension of mill solutions. In the course of these experiments several determinations were made by the drop-weight method. One determination gave: Surface tension of overflow, 65.9; of underflow, 69.8. This result is in accord with classic tests made to prove absorption, as given in textbooks on colloid chemistry. The quantity of oil necessary is minute, 0.1 lb. per ton of ore being ample. The oil was added to the charge in the cell, and the overflow could be drawn after an interval of a few seconds. Neutral water was used.

Precautions To Be Observed in Using Process

The process is simple when two "don'ts" are observed: (1) Don't grind in the presence of an insoluble oil; use it cautiously in any event; (2) don't grind samples in a disk pulverizer, and if the use of a ball mill instead of a pebble mill is contemplated, make careful tests to

TABLE III. RESULTS OF DISK AND MORTAR GRINDING

Ore Prepared In	Overflow, Grams	Copper in Overflow %	Copper in Overflow Grams
Disk	10	14.0	1.4
Mortar	24	16.2	3.9

see whether the iron surfaces of the balls have an injurious effect. This is especially important in connection with the statements of Zachert[3] and Gahl[4], showing that the use of iron balls has a beneficial effect.

[1]Rickard, T. A., and Ralston, O. C., "Flotation," p. 195 (1917).

[2]Flotco No. 1, furnished by the Flotation Oil and Chemical Co., 2 Rector St., New York.

[3]Zachert, Victor, "Beneficial Effect of Grinding with Steel Balls in Flotation," Min. and Sci. Press, vol. 114, May 12, 1917, p. 663.

[4]Gahl, Rudolf, "History of the Flotation Process at Inspiration," A. I. M. E., Bull. 117, September, 1916, p. 1656.

In the experiments described in this paper no apparatus was available for determining the effect of grinding with iron balls in a ball mill, but it was proved conclusively that, for the flow sheet used, the use of the disk pulverizer not only is objectionable but must be avoided for either wet or dry crushing. The same conclusion applies to a "made up" ore containing chalcopyrite. Two comparative runs were made. Each sample consisted of pulp that had been prepared for cyanide tests, and 30 grams of chalcopyrite. The copper mineral in one was prepared in the disk machine; in the other it was ground to the same degree of fineness in a porcelain mortar. Table III shows the relative flotability. The mineral prepared in the mortar overflowed much more freely and gave a higher grade product.

American Chemical Society Omits Its Spring Meeting

After consultation with the advisory committee and other members of the American Chemical Society, the directors of the society have voted to omit the spring meeting, which was to have been held in St. Louis this coming April. It is felt that transportation conditions are such that unnecessary travel should be avoided, and also that the chemists of the country are so busily engaged in meeting war needs that their work should not be interrupted for the purpose of conference at this time. The annual meeting of the society will be held in Cleveland, Ohio, in September.

Engineers in Government Service

The Engineering Council, through its American engineering service committee, has supplied during the last few months to various Government departments and bureaus, in response to their requests, several thousand names of engineers from which selections were to be made to fill a great variety of positions in uniformed and civilian service for the Army and Navy and other branches of the Government's activities in connection with the war, as well as for indirect service for manufacturers and contractors engaged upon Government war work.

To meet these demands the American engineering service committee has assembled in its offices in the Engineering Societies Bldg., New York, extensive lists and much detailed information concerning engineers in all branches of the profession throughout the country. It will readily be appreciated that if these lists are to be maintained in the condition most useful to the Government and to the Engineering Council, the committee should promptly receive information concerning each engineer who has gone into any kind of Government service, direct or indirect, so that a record may be made on his card in the committee's office.

Engineers to whom this request applies are urged to send their names at once, with their present addresses and occupations in the Government service, as well as a brief statement as to whether or not they are available for other service, to the American engineering service committee, Room 901, 29 West 39th St., New York. Other readers are asked to bring this request to the attention of such engineers or to send information directly to the committee.

The Engineering Council is an organization of national engineering and other national technical societies of America. It has approximately 40,000 members, each member society having duly elected representatives therein. The Council was created to provide for the proper consideration of subjects of general interest to engineers and the public.

Foreign Trade in Lead and Zinc

Lead imports in November, December and for 1917 are reported by the Department of Commerce as follows:

Articles and Countries	November Contents, Lb.	December Contents, Lb.	Jan.-Dec. Contents, Lb.
Lead Ore:			
Canada	332,144	316,116	8,700,182
Salvador	41,801	.....	44,918
Mexico	576,679	967,169	15,082,664
Chile	1,615,805	313,042	3,851,596
Peru	31,318	.....	400,963
Italy	.....	.....	46,719
England	.....	.....	8,609,804
German Africa	.....	.....	4,405,145
France	.....	.....	120,102
Panama	18,320	.....	24,404
Others	.....	.....	6,379
Totals	2,616,067	1,596,327	41,292,876
Lead—Base Bullion and Bullion:			
Dutch East Indies	.....	.....	837,028
Peru	182,391	9,823	268,368
Canada	278,825	1,109,050	2,700,168
Mexico	15,409,525	19,205,260	99,859,406
Totals	15,870,741	20,324,133	103,664,970
Lead—Pigs, Bars, etc.:			
Panama	.....	.....	61,076
Barbados	183	.....	3,323
Colombia	.....	.....	3,155
Haiti	.....	.....	39,133
Canada	.....	5,930	338,029
Guatemala	6,688	1,595	60,683
England	.....	.....	80,188
Mexico	3,143,275	1,552,892	10,840,682
Peru	.....	.....	18,948
France	.....	.....	89,086
Chile	.....	.....	8,769
British West Indies	.....	.....	27,313
Others	105	168	15,589
Totals	3,150,251	1,560,585	11,585,974

The gross weight of lead ore imported in December was 4961 long tons.

The actual tonnage of zinc ore imported in December amounted to 4885 long tons. The countries of origin and the metal contents were as follows:

Countries:	November Contents, Lb.	December Contents, Lb.	Jan.-Dec. Contents, Lb.
Canada	496,000	1,089,674	10,310,388
Australia	.....	.....	25,005,837
Mexico	4,776,904	2,913,317	91,394,204
Spain	.....	.....	12,166,840
French Africa	.....	.....	1,245,000
Italy	.....	.....	4,822,400
England	.....	3,500	3,500
Totals	5,272,904	4,006,491	144,948,169
Zinc in Blocks, Pigs, etc.:			
Costa Rica	2,125	.....	9,704
Panama	2,211	609	52,752
Cuba	12,570	5,044	285,464
Mexico	.....	.....	3,318
Ecuador	.....	5,658	13,238
Canada	17,972	64,561	114,338
Brazil	.....	.....	5,513
Colombia	.....	13,131	19,131
Jamaica	.....	.....	2,165
Others	.....	1,825	7,530
Totals	34,878	90,828	513,153

Imports of zinc dust in December, 1917, amounted to 53,370 lb., and to 801,337 lb. for the year.

Exports of lead and zinc were as follows:

Lead:	November Contents, Lb.	December Contents, Lb.	Jan.-Dec. Contents, Lb.
Pigs, bars, etc., produced from domestic ore	14,688,767	15,206,810	112,430,857
Pigs, bars, etc., produced from foreign ore	2,128,313	28,896,495	64,514,449
Zinc:			
Pigs, etc., produced from domestic ore	12,255,998	31,749,757	276,784,653
Pigs, etc., produced from foreign ore	2,495,615	14,358,928	127,777,49
Sheets, etc	3,777,189	2,648,400	31,650,879

Stamp Shoe and Die Making Begun in Transvaal

An account of what is said to be the first commercial production of shoes and dies for stamp batteries in the Transvaal is given in the September, 1917, issue of the *Journal* of the Chemical, Metallurgical and Mining Society of South Africa. The problem of developing a domestic supply of these necessities of the gold-milling industry, which was presented by the restriction of imports, was attacked by a committee appointed by the technical societies of the Rand in February, 1916. The committee reported that such manufacture was possible by utilizing existing accumulations of scrap shoes and dies and recommended a process of manufacture consisting, preferably, of melting in an electric furnace of the induction type, similar to the Kjellin.

A site and building were secured on the property of the Robinson Gold Mining Co. on the Witwatersrand, and construction of the furnace was begun in May, 1916. Current was switched on to the furnace on Sept. 3, 1916, power being obtained from the Victoria Falls and Transvaal Power Co., Ltd. The power consumption at the furnace was about 800-900 kw.-hr. per ton of steel melted. The best month, considering results, was July, 1917, in which 73 tons of castings was produced at a cost of less than £14 per ton, power consumption being 775 kw.-hr. per ton of steel melted. In addition to the melting furnace, a coal-fired pre-heating furnace was installed to save power by heating the scrap to redness before it is charged into the electric furnace, and so arranged that it also heats the drying stove.

Motor Fuel from Kerosene Distillates

Efforts are being concentrated by every progressive oil refiner, according to Frank P. Peterson, in a paper on the extraction of gasolene from natural gas presented at the February meeting of the American Institute of Mining Engineers, on the problem of destructive redistillation of kerosene distillates, which amount to a large fraction of the crude. Sufficient success and encouragement have been reached in this direction to insure that within the near future all excess kerosene distillates will be treated in this fashion. It is now evident that from 25 to 50% of such distillates can be economically converted for use as motor fuel or can be used by blending with casing-head gasoline. This will add to the total gasoline supply an amount equivalent to an increase of 10% in our total crude-oil production.

Cinnabar Deposits of Tuscany

American capitalists might find it to their advantage to investigate the cinnabar deposits in the Monte Amiato district of Tuscany. Some of these have been mined from remote times, though only since 1846 have operations been carried on systematically. The Almaden mines in Spain produce from 900 to 1200 tons of quicksilver per year, and the Monte Amiato mines from 600 to 700 tons per year, although but two of the six shafts are equipped with modern machinery, writes F. T. F. Dumont, U. S. Consul at Florence, Italy, in *Commerce Reports*, Nov. 22, 1917. Only half of the cinnabar-bearing land is owned by mining corporations.

Metals of High Boiling Point

The various published data on the vapor pressure and volatility of metals have been collated by J. Johnston, in *Journ. Ind. and Eng. Chem.*, 1917, 9, 873-878 (abstr. in *Journ. Soc. Chem. Ind.*). Formulas have been worked out for calculating the vapor pressure at any temperature. The following table gives the approximate boiling points of the principal metals at various pressures.

Metal	Melting Point °C.	Pressure in mm. of Mercury: 10—3 °C.	10—2 °C.	10—1 °C.	1 °C.	10 °C.	50 °C.	100 °C.	750 °C.
Cadmium	321	220	270	330	410	500	590	630	780
Zinc	419	290	350	420	500	610	700	750	920
Magnesium	651	380	440	520	620	750	860	920	1,120
Thallium	302	500	570	660	770	910	1,030	1,090	1,300
Bismuth	271	540	620	720	840	990	1,130	1,200	1,440
Antimony	630	540	620	720	840	990	1,130	1,200	1,440
Lead	327	620	710	820	960	1,130	1,290	1,360	1,640
Aluminum	630	730	830	950	1,090	1,280	1,440	1,520	1,800
Manganese	1,225	790	890	1,020	1,170	1,360	1,530	1,610	1,900
Silver	960	920	1,030	1,160	1,320	1,520	1,700	1,780	2,090
Chromium	1,510	980	1,090	1,230	1,400	1,610	1,800	1,890	2,200
Tin	232	1,010	1,130	1,270	1,440	1,660	1,850	1,940	2,260
Copper	1,083	1,080	1,200	1,340	1,520	1,740	1,930	2,030	2,350
Nickel	1,452	1,100	1,220	1,370	1,550	1,780	1,970	2,070	2,400
Iron	1,520	1,130	1,250	1,400	1,590	1,820	2,010	2,110	2,450
Arsenic	830	220	260	310	360	430	490	510	610

The figures given for magnesium, antimony, aluminum, manganese, chromium nickel and iron were calculated from a single observation.

Employers' Liability for Defective Steam Shovel

BY A. L. H. STREET*

The Alabama supreme court has approved a judgment against an iron-ore mining company for the death of an employee due to the falling of a steam-shovel dipper in connection with which decedent was at work. (Sloss-Sheffield Steel and Iron Co., vs. Harrison, 76 Southern Reporter, 47.) The court holds that the fact that an employer has used such safety appliances as are used by many operators engaged in the same line of business is not conclusive as to his exercise of due care in the matter and would not necessarily relieve him from liability for a defective condition in such appliances.

Aluminum Alloy from a German Zeppelin showed an analysis of: Aluminum, 91.92%; copper, 4.13%; iron, 3.27% and silicon, 0.65%, according to a determination made for *Iron Age*, which secured a small section of the L21, which was shot down at Cuffey, England, on Sept. 2, 1916. Magnesium has been reported to play an important part in the alloys used in making Zeppelins, but this is not confirmed in the analysis given. Aluminum has been known to be the principal constituent, and the lightness of the piece is conclusive evidence of this. But aluminum itself has a tensile strength of only 18,000 to 20,000 lb. per sq.in. and must be made stronger for use in airships. The incorporation of copper with aluminum is known to strengthen it. One prominent American company produces an alloy of 92 to 93% aluminum and 8 to 7% copper, which is claimed to have a tensile strength of about 35,000 lb. per sq.in. In this Zeppelin alloy part of the copper has been replaced with iron—apparently with intention, as it is not probable that this element would appear in so large a proportion as an impurity. It may be that it adds strength to the aluminum-copper alloy or it may increase the rolling properties. An authoritative estimate is that this particular alloy has a tensile strength of close to 40,000 lb. per sq.in. Such strength combined with its extreme lightness makes it a valuable material for airships. The presence of the iron is interesting. It is known that aluminum will dissolve a certain amount of metallic iron, forming a mechanical mixture but not a chemical union. The quantity of aluminum in the framework of a modern German Zeppelin is from 10 to 12 tons, according to the notes furnished a London journal by a French officer.

*Attorney at law, 829 Security Building, Minneapolis, Minn.

American Institute of Mining Engineers

Concluding sessions of the 116th meeting of the American Institute of Mining Engineers were marked by timely papers and lively discussions. Social functions culminated in the "Hoover" dinner at Hotel Biltmore and a visit to the aviation ground school at Princeton University. The next meeting of the Institute will be held in Colorado during the first week of September.

THE annual business meeting of the American Institute of Mining Engineers was held on Feb. 19, the second day of the New York meeting, and was briefly outlined in last week's *Journal*. Besides the election of President Sidney J. Jennings and the other new directors and vice presidents, the directors at a subsequent meeting elected C. W. Goodale as first vice president and J. V. N. Dorr as a director to fill the vacancy made by the elevation of Prof. R. M. Raymond to a vice presidency.

The New Requirements for Membership

The amendment raising the standard of membership was passed practically without opposition. The new requirements, amending Art. II, Sec. 2, of the constitution, covering new members, are as follows:

Members shall comprise all those persons who on the third Monday of February, 1918, were members of the Institute, and in addition thereto, all those thereafter elected or transferred into the class of Members.

A person to be eligible for election or transfer into the class of Members must be at least 27 years of age and must have had at least six years' employment in the practice of engineering, mining, geology, metallurgy or chemistry, during at least three years of which he must have held positions of responsibility in one or more of these fields.

Graduation from the scientific course of a college, approved by the committee on membership, shall be considered equivalent to two years' employment, as required in the previous sentence.

Employment as a teacher of engineering, mining, geology, metallurgy or chemistry, if in direct charge, may be considered a position of responsibility as specified in the second paragraph.

Persons employed in research or any scientific literary work or in teaching in the scientific departments of colleges, approved by the committee on membership, who at the same time are engaged in consulting or in the active practice of mining, geology, or metallurgy, shall be entitled to consider the time so spent in active practice as equivalent to an equal length of time of employment in positions of responsibility, provided the work done or the positions held seem to the committee on membership to warrant the equivalency.

The requirement of three years' employment in positions of responsibility may be waived by the committee on membership in the case of persons who have done notable original work in mining, geology, or metallurgy, or have won distinction by research or investigations in one or more of these subjects. By investigation or research is understood laboratory experimentation as distinct from investigations in literature or compilations of the work of others.

A person eligible for election or transfer into the class of Associates shall be one who, in the opinion of the committee on membership and the board of directors, is suitable for such election or transfer by reason of his interest in or connection with mining, geology, metallurgy, or chemistry.

Junior Associates shall comprise all students in good standing in engineering schools, who have not taken their degrees and are nominated by at least three members, two of whom must be their instructors. A Junior Associate may remain such not longer than five years after leaving the engineering school, at the end of which period his qualifications to become a Member or Associate must be passed upon by the committee on membership. If elected, he shall pay at that time the entrance fee and dues of a Member or Associate.

In case there is any question as to the classification of a candidate the committee on membership may require from him any evidence he desires to present, and the decision of the committee as to the proper status shall be final.

The last paragraph of Sec. 2, prescribing the manner of proposal and election of candidates, was not changed.

The technical session on mining and milling, Tuesday morning, was presided over by President-elect Sidney J. Jennings, owing to the absence of Prof. Robert H. Richards on account of illness. The opening paper dealt with some practical hints on the operation of bucket elevators by A. M. Nicholas, of Australia, who was able to be present and read his paper in person. Charles A. Van Winkle's paper on "Recent Tests of Ball-Mill Crushing" was read by title and discussed by Prof. John W. Bell, J. Parke Channing and B. Britton Gottsberger. Mr. Channing in introducing Mr. Gottsberger's written discussion said that the members of the Miami Copper Co. staff, being responsible for the introduction of the Hardinge mill in large installations in the Southwest, were much interested in the tests of the Marcy and Hardinge mills at the Inspiration Consolidated plant, but were under the impression that the Inspiration test installation was not going to give satisfactory results, and advised Mr. Hardinge against entering two Hardinge mills in this contest. The Miami company some time later was remodeling Section 6 of its fine-crushing and grinding department, and instead of rolls and two Hardinge mills for grinding 1000 tons of ¾-in. product to approximately 48 mesh, installed three 8 ft. by 36 in. Hardinge mills, with which the grinding for the 1000-ton unit is now being satisfactorily done. Mr. Gottsberger gave the following data regarding the work of the remodeled section:

Grinding Results at Miami Mill

"The grinding is at present done in two stages. Each Hardinge mill is driven direct by a 150-hp. motor through Wuest gears and runs at 20.6 r.p.m. The entire section tonnage is first subjected to single-pass crushing through one mill, the product passing to a 4 ft. 6 in. Dorr classifier. The overflow of the classifier is finished product. The sand product of the classifier, representing the oversize of the first mill, is divided equally between two mills of the same size, each operating in closed circuit with a 6-ft. Dorr classifier. The overflow of these classifiers is finished product, the sands being returned to the mills for regrinding. The product produced by this system of grinding is shown by the following average screen analysis of the tailings for the month of January, 1918: On 28 mesh, .0%; on 35 mesh, 0.1; on 48 mesh, 0.4 (cumulative percentage, 0.5); on 65 mesh, 3.8 (4.3); on 100 mesh, 14.2 (18.5); on 150 mesh, 14.8 (33.3); on 200 mesh, 6.3 (39.6); through 200 mesh, 60.4 per cent.

"The average tonnage handled in Section 6 by the three mills during the month of January, 1918, was 987 tons per day of 24 hours. The power consumed in grinding by the three mills according to wattmeter readings amounted to 7.475 kw.-hr. per day, equivalent to 7.57 kw.-hr. per ton. The power consumption for the

remainder of the work done in the total reduction from mine rock is small. We have no accurate wattmeter readings on this, but according to our regular power distribution, figured from ammeter readings, the power for preliminary coarse crushing, conveying and operation of the Dorr classifiers amounts to 1 kw.-hr. per ton. Therefore, the total power consumption from mine rock to finished product is 8.57 kw.-hr. per ton."

Flotation with Heavier-than-Water Media

The paper on "A New Method of Separating Materials of Different Specific Gravities" was the other interesting event of the Tuesday morning session. This paper was read by H. M. Chance for the author, Capt. Thomas M. Chance, who is now in the national service. Briefly, the method consists of the use of a floating medium having a specific gravity between that of the gangue and the valuable mineral. In a miniature apparatus the floating of coal from slate was demonstrated, the floating medium used being a mixture of sand and water. With a centrifugal pump a circulation of water under small hydraulic head was maintained through a perforated plate in the bottom of the "jig" or apparatus. This made, Mr. Chance explained, a "true fluid mass" of sand and water, about 12 in. high, having a specific gravity of from 1.2 to 1.8. Above this there was about 6 in. of clear water, which was kept circulating by the centrifugal pump. Coal and slate were put into the apparatus. The coal sank only to the level of the "fluid mass" of sand and water, while the slate sank to the bottom of the apparatus. By using heavier sands, a heavier medium may be secured. Preparations are being made to install an apparatus at one of the anthracite breakers. The work has not been carried into other fields as yet, though Mr. Chance was of the opinion that it might be applied to other separating problems upon further development. Material to be separated should be appreciably coarser than the sand used in the "fluid mass."

There was considerable discussion of this proposed method of separating, W. S. Ayres calling attention to a similar medium having been created years ago in a pipe put down in a caisson at the Brooklyn Bridge. In this case the "fluid mass" was 85 ft. high and the clear water reached the 100-ft. mark on the pipe. Mr. Ayres considered the novelty in Mr. Chance's method to consist in the agitation. Referring to methods of removing the separated minerals, J. V. N. Dorr spoke of a California invention for separating frozen from sound oranges in which the frozen oranges were floated off and the sound oranges, which sank, were taken out of the apparatus by a conveyor. Professor Locke thought that the method might offer the "next possibility in ore dressing" and said that heavy media were already being used, as, for example, tin and antimony bromide solutions. Discussion as to the patentability of the method brought out some humorous comment as to royalties and cost of the apparatus, J. Parke Channing adding the final quip in warning the inventor that he should be very careful not to let the least bit of air get into his centrifugal pump unless he were prepared to entertain a long lawsuit with Minerals Separation.

At the Tuesday afternoon session of the iron and steel division, the paper of most general interest was that of Prof. Henry M. Howe, on "The Erosion of Guns." This was presented and discussed by Hudson Maxim, of the Naval Consulting Board, who found the mining engineers and metallurgists somewhat "gun-shy" when he touched a match to some smokeless powder he had been exhibiting. Dr. Maxim told the engineers that the steel of captured German guns had been examined and was found not to be superior to that in the American guns. America had better steel and also, he hoped, better men. There was considerable discussion of this subject and also of the succeeding paper, by J. E. Howard, on "Transverse Fissures in Steel Rails." In the Petroleum and Gas session, presided over by A. F. Lucas, discussion centered on Matteson's paper on "Principles and Problems in Oil Prospecting in the Gulf Coast Country," and on the Requa and the Beal and Lewis papers on valuing oil lands and estimating future production of oil wells.

Interesting illustrated lectures were given in the auditorium on the third floor of the headquarters building, Tuesday afternoon, one of these being on the "Devastated Districts of France" and the other, by Mark R. Lamb, on "Bolivian Tin Mines," both stationary and moving pictures being shown. At the smoker in the evening, conforming with the spirit of the times, the talks were of a more serious nature than in previous years, but equally interesting. The speakers were: Capt. Hodder-Williams, of the British Army, now training prospective American officers at Columbia University; Capt. E. E. Dulieux, representing France; Lieut. Col. Boorman, of the British and Canadian recruiting organization; Samuel A. Taylor, of the coal division of the Fuel Administration; M. L. Requa, of the oil division of the Fuel Administration; W. L. Honnold, of the Commission for Belgian Relief, and W. Y. Westervelt, of the War Minerals Committee.

Besides the sessions on metallography of steel and on employment problems, on Wednesday morning, the annual meeting of the Woman's Auxiliary was held at 10 a.m. The new officers of the Woman's Auxiliary for the coming year are: President, Mrs. Robert C. Gemmell; first vice president, Mrs. Louis D. Huntoon; second vice president, Mrs. Karl Eilers; third vice president, Mrs. Levi Holbrook; secretary, Mrs. Sidney J. Jennings; treasurer, Mrs. Harris K. Masters. Mrs. H. P. Henderson was elected a director. Mrs. C. C. Burger is chairman of the Americanization committee and Mrs. H. H. Knox of the foreign relief committee; an emergency committee, the head of which is not yet named, will undertake knitting and other relief and comfort work for the Association of the 27th Engineers (the mining regiment). There was a lecture at 11:30 by Dr. Kellogg, formerly of the Belgium Relief but now of the U. S. Food Administration, who told of the limited rations now prevailing in England, France, Italy and Germany, and also gave the Woman's Auxiliary the schedule for the reduced—but still much above the European—ration that would soon be asked of the food-saving volunteers of America.

Employment Problems One of the Most Important Subjects of the Recent Meeting

At the morning session on employment problems, the statement made by H. M. Wilson, in his paper on "Mine Labor and Accidents," that 40.5% of 2497 fatalities investigated were due to the human element,

brought forth criticism, one member holding that, according to the records of his company, it was nearer 60%. In the discussion by B. F. Tillson, E. E. Bach and C. W. Goodale, the question arose as to who was the safer workman, the new man, ignorant but on that account cautious, or the old, experienced employee who was careless because of his familiarity with his work. It was held in the main that the latter was less liable to meet with accident. The opinion was expressed, however, that experience in years did not count as much as experience in working where "safety-first" methods were in vogue; that it was often difficult to get the old, experienced man who "knows all about it" to have respect for safety measures.

An excellent address was delivered by Dr. Thomas Darlington in presenting his paper on "Illness in Industry." Dr. Darlington did not read his paper, on account of its length, but emphasized its salient points in a most forcible way. Safeguards for the health of employees have a value in dollars and cents which Dr. Darlington maintained can be demonstrated in black and white in every case. The subject was briefly discussed by Dr. L. A. Shoudy, following which an interesting talk was given by Dr. E. E. Southard on the "Psychopathic Employee." Dr. Southard, who is the director of a psychopathic institute at Boston, dealt with those cases of abnormal mentality on the borderland of insanity, such as are found in moody employees or the simple-minded. At the suggestion of Dr. Southard, a resolution was passed reading as follows:

Resolved, That the board of directors of the American Institute of Mining Engineers be requested to appoint a committee to study with a similar committee of the National Committee on Mental Hygiene (if such shall be appointed) the problems of employment in relation to mental disease and deficiency, said committee to report as a joint committee to the two organizations, a year from date.

The last paper, on "The Employment Manager and Labor Turn-Over Reduction," by Thomas T. Read, was followed by discussion by C. R. Hook, who emphasized the importance of making the would-be employee's first impression of the plant in which he is seeking to work a good one. Mr. Hook's interesting discussion was cut short, unfortunately, as Bradley Stoughton found it imperative to give him the hook in order that the hungry mining engineers might be fed; still more grievous is it to relate that, due to the same cause, W. A. Grieves did not get a chance to unburden his mind.

Work Wanted for Crippled Soldiers

At the afternoon session, employment problems were further discussed, and the members experienced the novelty of listening to the presentation of a paper by a woman, Mrs. Frank M. Gilbreth. Maj. Frank M. Gilbreth, who had been employed by the German government early in the war to study the refitting of injured soldiers for industrial work, and is now engaged in similar work for the U. S. Government, was unable to attend. His discussion on "The Crippled Soldier in Industry" was ably presented in an informal way by his gifted wife and proved to be one of the most interesting of the session. In this connection a letter was read from Stanly A. Easton suggesting that from experiences with injured mine employees it was essential to their healing to show them that they could quickly resume gainful occupation; he felt that crippled soldiers should remain attached to the Army and military pay continued for at least one year. Secretary Stoughton also spoke, from his experience with the blind, of the necessity of overcoming the initial depression and quickly showing the afflicted that they can be restored to gainful occupations. Investigation has already been instituted at some plants to determine which positions may be filled by crippled soldiers, and this duty was urged upon all members. Besides the regular papers on the program of the employment division, there were short talks by F. C. Henderschott, of the New York Edison Co., on the corporation school; by Lawrence Veiller, of the National Housing Association, on the housing problem, especially as crystallized in caring for shipbuilders and munition workers; by Mr. Harrison, of the Russell Sage Foundation, on general economic conditions as investigated by his organization, the results of which are available to members of the Institute in over a dozen volumes on the shelves of the Engineering Society library.

Lively Discussion of Genesis of Sudbury Ores

At the session on geology and ore deposits on the afternoon of Feb. 20, the paper on the "Chilean Nitrate Industry," by Allen H. Rogers and H. R. Van Wagenen, was read by Mr. Rogers. In the discussion that followed, Prof. Waldemar Lindgren and Prof. Charles P. Berkey took part. Interest of the afternoon centred about the paper on the genesis of the Sudbury nickel ores by Hugh M. Roberts and R. D. Longyear, which was presented by Mr. Roberts. Prolonged discussion followed, in which Professors Berkey, Lindgren, Graton and Miller joined. Dr. G. F. Kunz remarked that the Sudbury ores were the most promising source of platinum in North America. L. P. Teas' paper on the "Relation of Sphalerite to Other Sulphides in Ores" was to have been presented by Heinrich Ries. Dr. Ries was absent, however, so the conclusion of the paper was read by S. H. Ball, presiding, who asked for discussion, in which Prof. Graton and Berkey joined.

Annual Dinner at the Biltmore

The concluding social features of the 116th meeting were a theater party for the ladies at the Century Theater, the president's reception at the Hotel Biltmore and the annual dinner at the same hotel, followed by informal dancing. The annual dinner was well attended, and the "Hoover" menu was found fully as enjoyable as the old style, both as to caloric and gustatory value. Mr. Hoover, who was unable to be present, wrote Secretary Stoughton the following letter, which was reproduced on the menu:

I am glad to hear that the Conservation Division of the Food Administration is to dine in spirit with the American Institute of Mining Engineers. Be cheerful about this dinner; every year the war goes on the butter pot will shrink in size—but it has disappeared in Germany. Some year or other, when we are living on the present German ration—they will crack!

Among the speakers of the evening were W. O. Hotchkiss, of the War Minerals Committee; Bainbridge Colby, of the U. S. Shipping Board, and President-elect Sidney J. Jennings. Retiring President Philip N. Moore, who acted as toastmaster, startled, if he did not shock, his auditors in introducing Mr. Colby by his reference to our War Department being in the hands of a temporarily reformed pacifist, and the distribution of public information in the charge of a temporarily reformed

muckraker. Mr. Colby, obviously surprised by this introduction, hastened to state that he had not come to criticise, but rather to urge representative citizens to stand behind the Government. Without indulging in grandiose prediction, he assured the engineers that the shipbuilding program was now going forward with satisfactory progress and said that the same was also true of aircraft production. President-elect Jennings, in a few brief remarks on the problems before the Institute and its members, stated that the greater coöperation and participation of labor in the management of industrial enterprises would likewise become apparent in the mining industry and constitute the principal problem of the mining engineer during the coming year. On Thursday, the members and visitors went to Princeton, N. J., where they inspected the aviation ground school and the university, after lunching at Graduate Hall and being welcomed by President John Grier Hibben of Princeton University. The autumn meeting of the Institute will be held in Colorado during the first week of September.

Santa Gertrudis Annual Report

The annual report of the Santa Gertrudis Co., Ltd., for the fiscal year ended June 30, 1917, reflects the situation affecting the company's property in Pachuca, Mexico. The report states that the current change in the political situation resulted in better operating conditions and a plentiful supply of labor. Production, however, was greatly curtailed through shortage in cyanide, but at the time of this report the mills were going again at full capacity. Mining and milling costs advanced materially, due to higher wage scales and greater cost of supplies, which, however, was partly compensated for by the increased price for silver.

At the *Compañia De Santa Gertrudis, S. A.* (the mining company), a total of 8856 ft. of development, or 65% of the normal amount of work, was performed.

Work in the north vein on No. 22 level was interrupted by a heavy flow of water, and diamond drilling is contemplated to explore below this depth. The new orebody in the mineralized hanging wall, noted in the last annual report, has been extended 95 ft. and shows an average width of 23 ft., assaying 1.22 dwt. gold and 12.0 oz. silver per ton.

On the No. 16 level, 1650 ft. south of the north vein, a new body of ore was opened up in two shoots aggregating over 190 ft. in length, with a width of 56 in., assaying from 1.5 to 1.96 dwt. in gold and evaluated at about 14 oz. of silver per ton. The ore reserves are estimated at 1,125,000 dry tons (short) containing 68,783 oz. gold and 13,756,756 fine oz. of silver.

During the period covered in the report, 214,110 tons of ore containing 12,556 oz. gold and 2,214,312 fine oz. silver were sold, representing an output of 61.1% of the normal capacity. The amount of water pumped from the mine averaged 785 gal. per min. and was handled without difficulty.

At the *Compañia Beneficiadora de Pachuca, S. A.* (the milling company), owing to cyanide shortage the mill ran at only 53.2% of full capacity; but at the time of this report it had resumed its normal output. During the year a bullion recovery of 89.84% was effected, and the average price that governed silver was 33.16d. per standard ounce. Pebble tube mills are being converted to ball mills as the result of successful tests, and while flotation experiments to date have made only a 65% recovery, they will not be discontinued for the present. The old Guadalupe mill remained closed for the year on account of lack of available ore, but 56 flasks of quicksilver were recovered from the old patio. At the new mill the average rate capacity per day of running time was 1111 dry tons, based on the entire 60-stamps 24-hr. continuous operation.

Coal-Mine Fatalities in the United States During Year 1917

By Albert H. Fay
United States Geological Survey

The abnormal conditions under which the coal mines were operated during 1917 are reflected in the accident records to the extent of an increase of 21% in fatalities over 1916. The reports of the coal-mine inspectors to the Bureau of Mines of the Department of the Interior during 1917 account for 2696 fatalities at the coal mines of the United States, as compared with 2226 for 1916. There has been and is still an unusual demand on the operators for an increase in coal production, which has been hampered by a congestion in freight traffic and an apparent shortage of labor. Available data indicate an increase of less than 10 per cent. in production. It is not possible to give the number of men employed in 1917, but preliminary reports to the U. S. Geological Survey indicate that in some states there was a slight increase, while in others there was a small decrease. Estimates by state mine inspectors in 15 of the smaller mining states, representing one-fourth of the industry, indicate about 10% increase in the number of employees. Therefore, the total number employed in 1917 may not be much in excess of 1916, namely, 720,971.

Those mines which were able to secure cars to market their coal were operated on a full-time basis, which adds to the number of days the individual miner could work, thus lengthening the time he was exposed to the mining hazard. The risk encountered by the individual miner is proportional to the time exposed. Other mines which were not so favorably situated as to dispose of their coal operated only part time. This condition results in an increase of certain dangers, especially those due to gas, dust and falls of roof, which would not obtain in the case of the mine operating full time.

The shortage of mine labor, which is urgently required to keep pace with the increased demand for coal, is due to the attractive wages in munition factories, enlistments, and drafts into the Army, a relaxation in immigration, and to emigration of many miners early in the war. It has been necessary, therefore, to employ new and inexperienced men from other fields to replenish this shortage. Many of the experienced mine foremen and safety engineers have either enlisted or been drafted into the Army, or secured more remunerative employment elsewhere, with the result that less experienced foremen have been placed in charge of some of the workings. With the exceedingly large demand for coal, it has not been possible for the operators and others concerned to give as much attention to accident prevention at the mines as under normal conditions.

Correspondence and Discussion

Merits of Gold and Base-Metal Mines as Speculative Investment

What kind of metal mining seems to offer the most stable and best chances for returns on money speculatively invested, now and after the war? In August, 1914, and for several months thereafter, the world war had a decided bearish action on practically the whole mining industry. Metal mines of all kinds curtailed production, prices of base metals dropped, and in some cases dividends were cut. As the war went on, however, the enormous demand for copper, lead, zinc, molybdenum and tungsten caused the greatest rise in the prices of these metals ever known.

The result of these high prices was heavy speculation in stocks of companies producing the metals, the formation of many new companies with properties in various stages of development, and the opening of old abandoned mines, known to have ore of sufficient value to permit profitable operation as long as the high prices prevailed. Old base-metal mines of established value increased production to the economic limit, and many went beyond it. By economic production is meant production which depends almost entirely on speed of development. Only that quantity of ore should be mined in a given period that can be matched in the same period by a like amount blocked out for mining. Those properties which, in order to take advantage of the high prices obtainable for their product, have gone beyond the economic limit, must sooner or later curtail production to return to the point where development keeps pace with it.

The entrance of the United States into the war has been followed by the arbitrary fixing by the Government of a price for the base metals, which has been much lower than the average obtainable before the legislation. A great many "war" companies have shut down, and others have curtailed their production. The prices of the stocks of these companies have dropped greatly, even of the old-established companies. The mining public has therefore on the whole lost considerably, which has resulted in a lessening of speculative interest in mines and mining of all kinds.

It is my opinion that this condition will be more noticeable after the war than at present. The reasons are that consumption of these metals will materially decrease, and prices will suffer another adjustment downward. The large companies have increased their plants and development to cope with the increased demand. The continuance of the same rate of production after the war would soon flood the markets, and the price obtainable for their product would still further drop. It is therefore certain that the majority of these mines will greatly lessen their output after the war, and this, together with the lowering of price of the metal, will result in greatly decreased earnings, which will have its corollary effect on the stock market, and the price of the stocks will drop. With this condition, the public interest in this kind of mining will cease, and speculative interest turn elsewhere.

Gold as compared with base metals presents an entirely different aspect. The increase in interest in base-metal mines due to the war caused a corresponding decrease in the interest in gold. The increase in market value of the base metals has had the effect of lowering the purchasing power of gold. The higher cost of material connected with mining has greatly lessened profits in the production of gold. The price of gold is standard, $20.67 per oz. The higher the price of materials, the less the purchasing power of gold, the greater the cost of production, and the lower the profit. This condition, which has been prevalent since the beginning of the war, has caused a curtailment of production in many gold mines, especially in low-grade ones, and in many cases lowered the margin of profit so that dividends had to be cut. These factors have had the effect of turning the interest of the mining public from gold, and have caused the industry to become more or less stagnant.

It is certain that after the war conditions will change. With adjustments of the price of base metals, gold will still remain at the standard value of $20.67. With the resumption of world commerce, the gold reserves of the world must needs increase, and this condition will call for greater production of the metal. With the lowering of price of commodities, the cost of production will be lessened materially. Larger profits will result from both of these last conditions. The speculative public will turn to gold and gold mines, and an era of great prosperity will start for those in any way connected with the producing of gold. From these premises it is reasonable to assume that gold mining will in all probability experience its greatest boom shortly after the cessation of hostilities.

HAMLIN BROOKS HATCH.

South Porcupine, Ont. Jan. 24, 1918.

Heap-Leaching

I was pleased on reading Mr. Young's comments on my heap-leaching paper. I believe Mr. Young is correct in pointing out that there will certainly come a distinct trend toward leaching for the treatment of low-grade ores. Leaching is basically correct in principle, and now that the actual plunge has been taken, and we have several important examples of large-scale work, Chuquicamata, Ajo, and the recent development of ammonia leaching, progress along these and other lines is bound to come. Referring to the details of the comments, I do not anticipate great difficulty in piling so as to secure relatively good uniformity of bedding. This I think will be largely a matter of the selection of the proper machinery for the purpose. Regarding sizing uniformity in comparison with, for example, cyanide leaching, we should, I think, recognize a relation be-

tween the bulk of material being treated, the time for treatment and the various sizes. In cyanide leaching we are dealing with small bulks of ore comparatively, requiring complete and intimate contact with the solution in a short time. In heap-leaching on a practical scale we will have to do with quantities as units, running up to hundreds of thousands of tons, and our available time of treatment is increased in a large ratio. In other words, considered in this way, the uniformity of a heap-leaching pile may be regarded as fully equal to that of material for other leaching purposes, which must be crushed and sized to a definite degree, on account of inherent limitations of method.

The leaching of the peripheral zone of a heap is, of course, a matter that will have to be considered with respect to the manner of solution application. Of course, solution applied directly to the top of a heap will not reach the peripheral portions. Distribution of solution to such portions, however, can be arranged easily. I do not know whether it will prove true that only a small part of the copper within a lump will find its way into the circulating solution. With our present knowledge I think this is a matter of opinion, and our experiments in progress will tell us the maximum lump that can be leached. I do not believe that aëration, and the presence of free oxygen, either in solution or otherwise, is so important as porosity sufficient to permit of percolation. I would prefer to say, therefore, that the depth of pile will be limited by porosity rather than by the power of the solution to carry oxygen well down into the bed.

Attention is called to the very important practical point of proper water-proofing. This will depend to a great degree on the ground itself. We have found at Bisbee that our solution losses are relatively small, even with a comparatively crude water-proofing. When the underlying ground carries lime, and especially if a "caliche" layer is near the surface, I do not think the water-proofing problem will be serious. Where a water-proofing layer is needed, which is naturally a matter for experimental determination, the relative order of preference would, I think, be, first, concrete and mastic, which, as pointed out by Mr. Young, will be expensive, although not prohibitively so; second, a layer of slime tailings, which are cheaply available in many localities, and, finally, a clay. I think there is no question that anything in the way of elaboration of apparatus or expedient beyond the simplest forms will prove too expensive, although, aside from cost, a number of these would be desirable. G. W. VAN ARSDALE.

New York, Feb. 16, 1918.

Crowning a Large Wooden Pulley

The Feb. 2 issue of the *Journal* carried a description of crowning wooden pulleys by taking them to a country shop, building up a rest and fixing a small lathe for the job. I have seen millwrights and carpenters do the trick, even on a wooden wheel 8 ft. diameter and 18 in. face, in a much simpler and more expeditious manner, by simply revolving the pulley in place on the shaft at the usual speed and holding the teeth of a carpenter's saw against the face of the moving pulley, using the saw as a wood turner would use a hand-turning tool in a wood lathe, and judging the effect by observing the periphery of the pulley, stopping to actually measure when the work was nearing completion.

Instead of being a rough job, as it would seem, it is a very good job, and I have used these same pulleys for years afterward, coupled with rubber belts, without seeing any excessive belt wear from method of squaring, or crowning, as the case may be. In a built-up wooden pulley the saw cuts through nails or screws quite readily. In most cases, all the saw needs afterward is resetting and sharpening.

New York, Feb. 25, 1917. S. H. BROCKUNIER.

Is Gold Mining Necessary During the War?

Not absolutely necessary at this stage of the war, when we practically control the gold reserve of the world; but I believe it would be the height of folly to curtail the output of gold in any manner, as it will have very little bearing on the outcome of the war. We all know that, calculated on the buying power of an ounce of the metal, gold has really depreciated from 35% to 50% of its value during the last three years.

Gold mining should be encouraged in every way possible where the operators are producing with a close margin of profit, due to gold depreciation, and even a taxation exemption should be considered. Gold, being the monetary standard of the world, will be absolutely necessary in the adjustment of conditions after the war is over. But the present gold reserve of the world does not represent 10% of the current values of exchange; a condition due to the exorbitant prices, high wages and inflated values placed on all properties and business operations. Bankers maintain that the gold reserve should be at least 25% for conservative banking.

I take this opportunity to ask a question for future discussion. The gold reserve being less than 10%, what will be the condition and how will the exchange problem be solved after the war when the countries of the world get back to normal conditions? Gold or other metals used as standards must retain their proportion to the money values of the world and this is impossible with gold worth $20.67 per oz., unless some other standard is adopted. The laboring class will never consent to a reduction in wages; the conditions of 1913 will never be seen again. So how will the problem be solved?

My answer is as follows: Since the United States Government, as well as other countries, has called in practically all gold coins, I suggest that the world refrain from any gold coinage and hold the gold reserves at the local seats of government. Gold can thus be placed at a premium, or, rather, a new standard, which will place the money situation on a sound basis. The manufacture of non-essentials, such as automobiles and other pleasure appliances, should be curtailed first; also unnecessary improvements on roads, buildings and parks could be abandoned until after the war. Many things should go before the suspension of gold mining is even thought of, because it is the one basis of stable government. We cannot do without it unless we have something to replace it for, under normal peace conditions, the world's business can be conducted on the theory of "I owe you and you owe me" only to a limited extent.

Maiden, Mont., Feb. 7, 1918. E. B. COOLIDGE.

Events and Economics of the War

War on Russia was resumed by Germany at the expiration of the truce on Feb. 18; Teuton forces are moving eastward to occupy the Baltic provinces; a third force is operating in the Ukraine; no resistance has been encountered and several thousand prisoners and much war material have been taken. In Paris, Senator Humbert was arrested as a sequel to the Bolo trial. In Great Britain, Sir Henry Wilson succeeded Sir William Robertson as chief of staff.

In the United States, treaties were signed with Great Britain and Canada by which the latter countries may draft Americans between the ages of 21 and 31 within their borders, and the Federal Government may likewise call into service British citizens from 20 to 45 years old who are resident here. The next Liberty Loan was forecast by Secretary McAdoo at 4½%. Secrecy in connection with Army contracts was ordered abandoned by Secretary Baker. The Administration's railroad bill passed the Senate with few changes. The President, by proclamation, reaffirmed the $2 base price for the 1918 wheat crop. Viscount Ishii was appointed ambassador to Washington from Japan.

Rice Talks to Mining Engineers on Coal Problem

In discussing the fuel problems of the day at the New York meeting of the American Institute of Mining Engineers, George S. Rice, of the U. S. Bureau of Mines, said in part:

"The problem of the Fuel Administration is a terrific one. It is not only a problem of production, but also one of transportation. In general, it may be safely asserted that the mechanical capacity of the mines in this country is amply able to take care of all its needs, but to obtain this capacity the mines must have sufficient railroad cars regularly to ship their output, and the loss of a day's output is one that cannot be made up. Some have imagined that coal can be stocked in the mine, but, as a matter of fact, that is not possible, at least for more than a day's run.

"It may also be asserted that there are enough men to produce the necessary coal, in spite of the diminished numbers, if they could and would work every day. 'Could' means railroad cars and mine supplies; 'would' refers to their willingness to stay on the job every day it is possible to work. The miners on the whole have been making large earnings, first because of the regular work that has been offered to them; second, because of the increases in the labor rates, which have been very large in some parts of the country. This has caused the indifferent miner to take self-appointed holidays when he should be at work. These are serious problems to the operators and to the Coal Administration.

"This country has drafted its young men for the greatest sacrifice that a man can make. Is there any logical reason why all able-bodied males should not be compelled to do at least eight hours' work every working day until this war ceases, for which they will be paid far beyond what the man who makes the greatest sacrifice is paid?"

Safeguards Against Poisoning by TNT

One of the greatest dangers to workers in the highly developed munitions industry lies in the nitro and amido compounds of benzol and toluol, one of which is trinitrotoluol, a powerful explosive. Workers are exposed to the latter in its manufacture and in shell-loading. It is readily absorbed through the skin and respiratory tract. Although such absorption cannot be prevented altogether, it can be made so slight that no workers, except, perhaps, those especially susceptible, will have symptoms of chronic poisoning.

The Public Health Service of the Treasury Department has published an article giving practical points on safe handling of trinitrotoluol and dealing primarily with the shell-loading processes, of which there are two. The compound is either pressed into the shells by power presses while in powdered form, or is poured into them while molten. In the former method, used only in the case of large shells, simple measures will prevent poisoning. The article therefore deals principally with precautions to be taken where the latter method is used.

It is recommended that workrooms be constructed to secure complete segregation of each stage in the process of loading; that long, narrow, one-story buildings be used; that a conveyor system be adopted to avoid unnecessary handling of the substance; that workers be instructed as to the danger of poisoning; that they secure as complete protection of the person as possible by overalls, caps and gloves; that they avoid all alcoholic beverages; that they take milk or milk products with their breakfast previous to starting work; that they observe the strictest personal cleanliness; that persons under 21 be kept from handling the compound, as they are especially susceptible to the poison; that men be employed for only eight hours a day when working with trinitrotoluol; that those employed in the most hazardous parts of the work be rotated to less hazardous processes at least every two weeks; and that an efficient system of medical supervision be established.

Refineries Losing Men to Government

The high wages paid on Government construction work have taken men from private manufacturing in the vicinity of New York to such a degree that production of materials essential to the conduct of the war is threatened. It has been learned that certain companies have appealed to the Government for assistance, so serious has the matter become. Among them are the following:

American Smelting and Refining Co., the Anaconda Copper Mining Co., the United States Smelting Co.,

with a big refinery at Chrome, N. J.; the United Lead Co., which is a subsidiary of the National Lead Co.; the Barber Asphalt Paving Co., engaged in making road material for the various cantonments; the Pardee Steel Works, and the Roessler & Hasslacher Chemical Co. One of these companies is said to be paying at the present time 38c. per hour for an eight-hour day, compared with the normal wage of about 23½c. Coming into competition with the demand for labor with the builders of shell-loading plants, hospitals, powder plants, etc., whose contracts with the Government are on a "cost-plus-profit" basis, the copper men say that they cannot hold their workmen. The current wage on the Government operation is 40½c. per hour for a ten-hour day, with time and a half for overtime.

Boosting the Engineer

Steps to acquaint the Railway Wage Commission with facts as to recognition and compensation for technical engineers have been taken by the American Association of Engineers. The association maintains that it acts thus not solely in the interest of its members, but to aid all engineers, without regard to their affiliations or particular branch of technology. In a communcation addressed to the Wage Commission, the association points out the high efficiency and large earning capacity of the Pennsylvania R.R., and notes the significance of the fact that a civil engineer has been its chief executive for many years. The road's policy, it says, has been to secure technical engineers for service in its various departments, that they may apply their trained minds to the betterment of their branches of the service.

This practice of the Pennsylvania company, however, is exceptional, the association claims. In many cases, roads built by technical men are operated and maintained by non-technical men who have obtained their experience at the cost of the roads. The engineering departments retained by the roads for self-preservation are generally treated in rather niggardly fashion, both as to the pay and number of men they are allowed to employ. Says the association:

> It has taken a world tragedy, the tragedy of war, to arouse the nation to an appreciation of the value of its technical men. This great strife is not, as in other ages, a contest of brute force in which the bulkiest muscle is bound to win, but it is a battle of intellectual giants struggling for supremacy in destructive creation and protective and defensive development. The civil engineer, the mechanical engineer, the electrical engineer, the mining engineer, the chemical engineer, the aeronautic engineer, the marine engineer—a great coöperative brotherhood working for peace and victory—have cast their skill, knowledge and effort into a crucible from which our country is drawing the metal from which victory will be fabricated and a world peace be secured.

Manufacturers and the Labor Problem

Manufacturers need missionary work as well as do workers to arouse them to the needs of the present situation, according to Roger W. Babson, who recently toured the West as a special agent of the employment service of the Department of Labor.

"The labor difficulty at present is one of improper distribution, rather than of shortage," said Mr. Babson. "The complaints of manufacturers, I have found, have arisen not so much from their difficulty in obtaining labor, but in their difficulty in obtaining it at the prices which the manufacturers desire to pay. My principal difficulty was in convincing manufacturers of the increase in the cost of living to wage earners and in the reasonableness of advancing wages.

"The manufacturers who are not complaining about paying advances of 100% or more for materials which they must use are strenuously objecting to paying a fraction of this advance in wages.

"In many ways manufacturers are more liberal than wage earners. They cheerfully pay heavy taxes, give bountifully to the Red Cross, and similar organizations, are willing to work in Washington for $1 a year and permit their wives to knit from morning to night, but there is one thing which they will not do: give up one-sixteenth of the so-called 'inherited rights of the employing class.'"

National Labor Board Appointed

Capital and labor have named the five representatives which each was asked by the Government to appoint to outline a basis of relations for the period of the war. The first session of the conference was held in the office of Secretary of Labor Wilson on Feb. 25.

The representatives of the employers are: Loyal A. Osborne, New York, vice president Westinghouse Electric and Manufacturing Co., and chairman of the executive committee of the National Industrial Conference Board; Charles F. Brooker, Ansonia, Conn., president of the American Brass Co.; W. J. Vandervoort, East Moline, Ill., president of Root & Vandervoort Engineering Co.; L. F. Loree, New York, president Delaware and Hudson Co.; and C. Edwin Michael, Roanoke, Va., president of the Virginia Bridge and Iron Company. The representatives of the workers are: Frank J. Hayes, president United Mine Workers of America, Indianapolis, Ind.; William L. Hutcheson, president United Brotherhood of Carpenters and Joiners of America, Indianapolis, Ind.; J. A. Franklin, president of the Brotherhood of Boilermakers and Iron Shipbuilders of America, Kansas City, Kan.; Victor Olander, representative, International Seamen's Union of America, Chicago; T. A. Rickert, president United Garment Workers of America, Chicago.

"Agreements on principles and policies which would govern the relations between employers and workers during the war," Secretary Wilson wrote each of the representatives of capital, "will greatly facilitate the formulation of a national program and will contribute largely to a successful administration of that program."

Among the problems facing the board are the following: The basis for wage determination; strikes and lockouts; piece-work prices and price-fixing; method of eliminating improper restrictions on output of war materials from whatever cause; practice to govern dilution of labor; discrimination against union and non-union men; admission of union agents to plants; method of promptly adjusting disputes at their source through boards containing equal representation of employers and employees; right of workmen to organize.

Prevention of disturbances rather than the cure of them will be the central doctrine of the Government's entire policy. Reorganization of the Labor Department

will seek to eliminate duplication of effort and conflicting action by various departments in an effort to obviate friction. Where friction arises, the department's adjustment service will endeavor to remove the cause before interruption of production results.

Electrification of All Railroads Urged

Nation-wide electrification of railroads as a solution of the fuel and transportation problems of the United States was urged by E. W. Rice, Jr., president of the General Electric Co. and of the American Institute of Electrical Engineers, at the opening of the institute's mid-winter convention recently held in New York.

"Where electricity has been substituted for steam in the operation of railroads," Mr. Rice said, "fully 50% increase in available capacity of existing tracks and other facilities has been demonstrated."

He said that electric engines speeded up schedules as high as 25% and that the cold weather that paralyzed the steam lines did not hurt those electrically operated. He declared that electrification of the roads would save 100,000,000 tons of coal in one year, or three times as much as the total coal exports of the country, while 10% of the ton mileage of all of the roads now given to the transportation of coal could be saved by the use of current. In addition to coal waste he asserted that 40,000,000 bbl. of oil, or nearly 15% of the total output, went to engines and could be saved by electricity.

Mr. Rice said that 25,000,000 hp. of water-power was available in the United States for the generation of electricity to run the roads, and that every horsepower of water would save at least six pounds of coal for each horsepower-hour of traffic.

"It is really terrifying," declared Mr. Rice, "to realize that 25% of the total amount of coal which we are digging from the earth each year is burned to operate our railroads under such inefficient conditions that an average of at least six pounds of coal is required per horsepower-hour for the work performed."

Putting the College Behind the Army

With a view to mobilizing the educational institutions of the country and their facilities for special training, there has been created in the War Department a Committee on Education and Special Training. Associated with it will be five civilian educators, known as an advisory board of educators. The functions of the committee will be to mobilize the country's schools and colleges behind the Army. It will encourage and arrange for the technical education of men needed by the several branches of the Army, particularly the Ordnance Bureau, the Signal Corps and the Engineers. It is estimated that within the next six months 75,000 to 100,000 men of the nation's armed forces will be given intensive training in the schools and colleges. In a degree the educational institutions are already rendering patriotic service to the Government, but it is planned that there shall be a systemization of their efforts and that their facilities for technical training shall be fully utilized.

The committee will be composed of Col. Hugh S. Johnson, Deputy Provost Marshal General; Lieut. Col. Robert I. Rees, of the General Staff, and Major Grenville Clark, of the Adjutant General's Department. The five advisory members of the committee, whose selection has been approved by the Secretary of War, are: Dr. Charles R. Mann, of the Carnegie Foundation for the Advancement of Teaching and the Massachusetts Institute of Technology; Dr. James R. Angell, of Chicago, dean of the faculties of the University of Chicago; J. W. Dietz, of Chicago, director of education, Western Electric Co.; president of the National Association of Corporation Schools; James P. Munroe, of Boston, a member of the Federal Board for Vocational Education (which appointment will include the interests of the trade schools and schools of secondary grade), and Dr. Samuel P. Capen, of Washington, specialist in higher education.

Coal Situation in France

Before the war France consumed annually a total of approximately 65,000,000 tons of coal, of which, in round figures, 41,000,000 tons were of domestic production and 24,000,000 tons were imported from abroad, that is to say, from Great Britain, Germany, and Belgium. The monthly consumption in peace times thus amounted to 5,400,000 tons, according to *Commerce Reports*. In 1916, the domestic mines produced only 20,000,000 tons and the imported coal amounted to only 19,000,000 tons, making the total quantity available for consumption 39,000,000 tons. In November, 1916, a typical month, the French mines produced 1,800,000 tons of coal and the imports amounted to 1,500,000 tons, the available monthly supply being, therefore, 3,300,000 tons, which represents a deficit, compared with the monthly consumption in 1913, of approximately 40%. It should be noted, however, that the above average for 1913 includes also the summer months, whereas the consumption is necessarily greater in the winter months. The figures for December, 1916, compared with the monthly average of 1913, indicate a diminution of 44 per cent.

The following figures illustrate the great increase in the domestic production of coal during the last two years. In October, 1915, the French mines produced 1,700,000 tons; in October, 1916, 1,800,000 tons; in October, 1917, 2,782,000 tons. In November, 1915, the French coal mines produced 1,500,000 tons; in November, 1916, 1,600,000 tons; and in November, 1917, 2,690,000 tons, or an increase of about 80% in the two years. It should, of course, be noted that the invaded portions of France contain the principal French coal mines, and that therefore the war has cut off the chief source of supply and has made necessary the more intensive exploitation of the mines in the uninvaded regions.

Tunneling the Bosporus

The Turkish Parliament is said to have approved a bill providing for the construction of a bridge and tunnel across the Bosporus, connecting Europe and Asia. Contract for the work has been awarded to a Budapest firm, and it will begin operations in April. The Bosporus is at the entrance of the Black Sea, connecting that sea with the Sea of Marmora. At its narrowest point the Bosporus is 1800 ft. across.

Industrial News from Washington

By Paul Wooton, Special Correspondent

Curtailing Imports a Knotty Problem

Far-reaching action affecting the use of ocean bottoms may be expected in the near future. Imports and exports that are not needed within the next few months, and the transportation of which involves delay to shipping, will be stopped. The problem now being worked out is that of determining which commodities are needed so acutely that ships must be furnished for their transportation in the face of the demand for tonnage which is required for troop, munitions and food movements.

It is recognized that the shipping crisis will be acute until August. After that time, there is every promise that the building program will exceed losses. Military accomplishments during the next five months will be determined to a considerable extent, it is believed in Washington and in London, by the tonnage of shipping which can be devoted exclusively to military uses.

The matter of determining which of the mineral imports and exports may be reduced or eliminated from ocean transportation will be in the hands of a Shipping Board-War Trade Board committee, of which C. K. Leith is the head. Another member of the committee is J. E. Spurr. It is understood that the War Industries Board also will be represented. Business men of recognized standing will be asked to sit with the committee in formulating suggestions. This committee expects to make an early recommendation. As a basis for action by the War Trade Board in licensing mineral imports, an attempt is being made through several Government agencies to bring together all information bearing on questions of mineral imports, and when possible representatives of mineral trades affected will be consulted.

In some quarters in Washington it is believed that importers of a number of minerals have been favored unduly in the matter of ship assignments. Objections have increased in volume, until an absolute determination of the matter is promised in the near future. What is regarded as an inspired statement of the attitude of the importers was made recently as follows:

"With ships returning from Europe in ballast as they constantly are, the necessity for imposing restrictions on imports is not apparent. Some imports from Spain may be curtailed, but the greater part of the saving of tonnage would have to be effected in the Latin-American trade. It is there, however, that the United States hopes to establish a commercial advantage which will be permanent.

"The experts are finding that it is impossible to determine what classes of imports are non-essentials. A non-essential to American consumers is not necessarily a non-essential to the country producing it. Aside from the fact that imports that might be cut off are necessary for the maintenance of the world's balance of credit, so many of them that at first glance might seem non-essential are found, upon investigation, to be essential to American industries that it is proving a knotty problem to prove when an essential is not an essential. The situation is being influenced by foreign governments whose industries would be affected. They are making inquiries through diplomatic channels which indicate that they will not allow their industries to be jeopardized without vigorous protest. Retaliatory action in many cases is regarded as probable."

Lane Discusses Problem of Cutting Mineral Imports

War minerals to the extent of 2,000,000 long tons are being imported. Three-fourths of this tonnage can be eliminated in case of extreme necessity, officials of the U. S. Bureau of Mines have concluded. To cut out so large a part of the mineral imports, much technical work is necessary, which is described by Secretary Lane substantially as follows:

A large force of metallurgists should be set to work immediately on the changes necessary in practice to use lower grade manganese alloys. Field parties of engineers and geologists must take samples for quick concentration tests to improve the quality of the domestic materials. A group of engineers must be organized to encourage the development of new pyrite mines and to determine the need for priority assistance in the shipment of materials and products.

The concentration of chromite ores is an immediate and pressing problem, as two-thirds of our supplies still come from abroad.

Improved milling methods and a study of the use of domestic graphite in crucibles would increase the domestic production of this material very rapidly. Under present uncertain conditions, the graphite industry is threatened with serious curtailment, rather than expansion.

It is absolutely essential that the consumption of such products as tungsten and quicksilver be supervised and checked carefully to make sure that these materials are used properly and kept out of alien enemy hands.

The producer of imported minerals in undertaking new operations needs information and assistance to hasten his production. The consumer in changing to new materials needs technical assistance to prevent disturbance and interruption of his production. Technical investigation must precede the radical changes involved.

In order to initiate this work, the Bureau of Mines is asking for an appropriation of $150,000. This is to be devoted principally to work on nitrates, pyrite, sulphur, manganese, graphite, quicksilver, potash, tungsten, antimony, chromite, magnesite and mica.

Limiting Non-Essential Industry

Of decided comfort to those industries which feared an arbitrary classification as non-essential was the Fuel Administrator's recent order making it plain that a different policy would be tried out at least. With the

consent of the manufacturers, an order was issued limiting the use of fuel for the production of common window glass to 50% of the amount manufactured in 1917. This action was taken after agents of the Fuel Administration had discovered that there would be overproduction of window glass in 1918. Most manufacturers were willing to reduce output when they were given the assurance that their competitors would be bound by the same restriction. This situation brought out an announcement reading in part as follows:

The Fuel Administration is carrying on a series of conferences, covering all industries which use large quantities of fuel, with a view to learning the requirements of each line during 1918. The aim of the Fuel Administration is to arrive at a percentage of production which, under the circumstances, will be satisfactory to manufacturers and their workmen, but which will not represent a consumption of fuel for the manufacture of supplies not needed during the current year. It is through this system of scientific limitation, together with large economy in the methods of using fuel, that the Fuel Administration expects to supplement the production of coal this year.

Decision on Pyrites Question

Imports of iron pyrites are likely to be suspended entirely. The requirements of this country are to be met by increased domestic production of pyrites, by increased production of pyrites in Canada, and by substitution of sulphur where requirements cannot be met by the pyrites produced in the United States and in Canada. A large quantity of sulphuric acid is available from smelting plants.

Specialists who have studied the matter are satisfied that sulphur reserves are sufficiently large to meet the heavy demand, which will thus be thrust upon them, without interfering with the supplies going to the wood-pulp industry and to the Allied governments. Ocean tonnage will thus be conserved and domestic production of iron pyrites and pyrrhotite will be stimulated.

Importation of other mineral supplies, such as manganese ore from Brazil, is to be curtailed. The West Indies and Central America are to be scoured for ores to take the place of those from Brazil. Every effort will be made to stimulate domestic production. To ascertain the capacity of nearby countries to supply manganese ore, Albert W. Burch, representing the U. S. Bureau of Mines, and E. F. Burchard, of the Geological Survey, will make an extended trip at once to Cuba, other parts of the West Indies and to Central America.

New Minerals Board Formed

To coördinate the Government's work on war minerals, a Joint Information Board on Minerals and Their Derivatives has been formed. Pope Yeatman has been suggested for the chairmanship of the board by Bernard M. Baruch, of the raw materials section of the Council of National Defense. E. S. Bastin is to be the secretary of the board.

Each Government agency interested in minerals will have a representative on the board, which will be a central source of information through which all inquiries as to minerals will be routed. In case information is needed from different sources, the matter will be compiled and issued as one document by the joint board. The agencies to be represented on the board, at the beginning of its work, are: The Geological Survey, the Bureau of Mines, the War Industries Board, the War Trade Board, the Shipping Board, the Food and Fuel administrations, and the departments of Agriculture, Commerce, Treasury and State.

Graphite Situation Easier

A measure of relief has been afforded graphite producers in Alabama by the lifting of the embargo on certain shipments. Representative Heflin, in whose district the graphite industry centers, feels confident that an understanding has been reached with the War Trade Board which will prevent any further importations of graphite for uses which can be met by the domestic product. George A. Sharpe, of Ashland, Ala., is the president of the Alabama Graphite Producers' Association. He has been active in the negotiations between the authorities in Washington and those interested in the Alabama production. It is Mr. Sharpe's contention that the War Trade Board acted unwisely when it permitted the importation of large quantities of graphite from Madagascar and Ceylon, thereby taking out of other service much needed ships, when large supplies of Alabama graphite were prevented from reaching domestic markets by reason of railroad embargoes.

Dollar Exchange Now Established with Chile

Dollar exchange with Chile is at last a reality, it is announced. It is heralded as a result of the Pan-American Financial Conference held in Washington in May, 1915. The proposal was made to the conference by Leopold Frederick, treasurer of the Braden and the Chile Copper companies. Under the present arrangement, the Chilean government will allow part of the export duties on nitrate of soda to be paid on 90-day bills drawn on New York. Formerly the export duties were payable only in gold and in bills on London.

Prospecting for Nitrate in Death Valley

Systematic prospecting of nitrate deposits in the Death Valley region of southern California by several geologists of the U. S. Geological Survey and a force of workmen is now under way. The occurrence of nitrate in certain clay hill deposits in that region has long been known, but development work done thus far seems to have been merely an effort to comply with the requirements of mining laws rather than to determine the workability of the deposits. The present work is confined to trenching and sampling, but the Survey is prepared to do deeper work if it be found advisable.

Save the Ammonia

The Government could use for munitions alone 20,000,000 lb. more ammonia than can be furnished by all the plants in the country working at maximum capacity, it has been announced officially. An appeal has been made by Herbert C. Hoover to stop all leaks through which ammonia is being wasted. Mr. Hoover suggests that it may be necessary to limit refrigeration and ice making to the most efficient plants.

Editorials

A Minerals and Metals Administration

WE HAVE set forth, in many editorial articles, the opinion that the Administration in Washington should include a central executive board with plenary authority. Whether this should be called a War Cabinet, an Executive Committee, or a Board of Vice Presidents is immaterial. The essential idea is to have a surveying and planning chief. A month or two ago we awoke suddenly with an appreciation that the crucial thing in our entire plan was ships. This had been becoming increasingly evident since last March. "Had we possessed an adequate statistical force, under control of a real general staff, or a real national planning committee or chief," says Raymond B. Price, "this weak link would have been expressed in mathematics so convincing that not even a week's delay in strengthening it would have been tolerated by the people or their leaders." Instead of which we had the four months' squabble between General Goethals and Mr. Denman, and then some more.

Now, we do not suppose that we are going to have the benefit of a real general staff. The Administration seems to be opposed to it, for some unfathomable reason. Nevertheless, we shall not cease to point out the vital necessity for such an organization. If there were such an organization, we conceive that one of the important divisions in it should be a minerals and metals board. That board should be comprised of men experienced in the mineral and metal industries. The minerals and metals board should be divided into a production branch and a purchasing branch. These branches should be, in turn, in the hands of experienced men. Everything relating to minerals and metals should come to this board.

As illustrative of the chaos that has existed heretofore, and still exists, we may say that we ourselves, during the last 11 months, have been requested to give advice or assistance respecting minerals and metals, or we have had other relations pertaining to the same subject, with the following boards, bureaus and commissions.

War Industries Board.
War Minerals Committee.
War Trade Board.
Bureau of Mines.
Food Administration.
Federal Trade Commission.
Priority Commission.
Ordnance Department U. S. A.
Navy Department, Bureau of Supplies and Accounts.
War Credit Board.

There may be others that we have forgotten. In some cases we have known these boards to come into conflict with each other on matters of considerable importance. We have known matters of international interest to become so involved in interbureau tangles that nothing could be accomplished until private individuals stepped in and applied ordinary business methods to the problem, with the thanks of distracted and confused officials and bureau chiefs.

We are not saying these things with any special reference to the members of the regular bureau staffs in Washington. Among them are to be found the efficient and the inefficient. Many of the committees that are manned by dollar-a-year men are just as bad as the most inefficient of the departmental bureaus. We are not sure that some of them are not worse. Some of the dollar-a-year men have entered upon the exercise of official authority with the keen relish that obscures wisdom. But fundamentally it is not the system, but rather the lack of system, that is at fault.

There is talk now of creating a mines administration. This plan originally was formulated in a bill by the War Minerals Committee. The terms of that bill (never introduced) would have permitted the proposed administration to do almost anything it chose. The mining industry, alarmed by the troubles that Governmental interference in its affairs had caused already, did not assent to the proposal; therefore, its promoters excluded from its terms aluminum, gold, silver, steel and iron, copper, lead, zinc, coal, and petroleum, and are now requesting support for the modified bill. There are other great branches of the mining industry that might also have been excluded as being well able to take care of themselves—cement, for example—but before anybody commits himself to the modified bill, he should examine it carefully.

The main point that is in the minds of the War Minerals Committee is the promotion of the production of such minerals as pyrites, manganese ore, magnesite, chrome ore, graphite, etc. This has been taken up by the Secretary of the Interior, who says that the development of American mines would supply two million tons of minerals now imported and allow the vessels to carry additional food and supplies to our army in France. We do not think that this brochure is worthy of Secretary Lane. He has been ill advised when he has been told that our importations of tin (tin ore), sodium nitrate, and antimony can be replaced by the development of mines in this country. His own bureaus ought to tell him that a quarter of a century of search has failed to reveal any promising tin mines in the United States, and that if we want tin we must still rely upon Bolivia and the Far East; that until we have instituted the production of nitrate from the atmosphere, we are bound to import sodium nitrate from Chile, and that the phenomenally high prices for antimony failed to stimulate in this country any large production of that metal, which without any doubt we shall have to bring from China, as in the past. There are some minerals heretofore imported that can be produced in the United States and are being produced in greatly increasing quantities, for example, manganese ore, chrome ore, and magnesite, but it is the stimulus of high prices that is effecting it and not anything that Secretary Lane has done or is

going to be able to do. We wish that there were less grand-stand play in Washington.

There is need for a minerals and metals board as part of a real plan of organization, a real general staff. If there were such a board, it might perhaps have checked Secretary Lane's last communication. Such a board should consist of experienced men who think in terms of minerals and metals, who would examine every proposed move by every other major division of the staff, and report the probable effect upon the minerals and metals industries. One of our great industries, one of far more importance than those that are being paraded now for appropriation purposes, is in a critical condition. Imperfect understanding of it, and perhaps sheer ignorance, in correlated departments have stood in the way of ameliorating a threatening situation. A minerals and metals board viewing things broadly, and having the power that it would acquire under a general staff (and in no other way) would be attending to this. Under our existing system the situation receives practically no attention. We simply wait for something to crack.

The Scarcity of Tin

IF WE had a properly constituted minerals and metals board, on the lines indicated in the previous editorial, one of the first things that it would do would be to direct its attention to the existing scarcity of tin, and it would do it in the following ways:

In the first place, it would, through other branches of the Government, urge curtailment of consumption for purposes that are unnecessary, or for purposes that are amenable to substitutions. For example, a good many things that are put up in tin cans might temporarily, and perhaps permanently, be put up in paper, pasteboard, or glass. A good deal of tinfoil is used as wrapping in packages of cigarettes and other small articles, wherefor it is not only unnecessary but also is a nuisance to the user. Many articles now made of tin or tin plate might just as well be made of sheet zinc.

The next natural step would be to recover tin that is thrown away in processes of manufacture. The recovery of tin from tin-plate scrap is already a well-organized industry, but all over the country there are junk smelters who are remelting bronze junk and wasting tin in their slags. By proper instruction they could be caused to recover tin in the form of matte, instead of wasting it in slag.

The most important way of increasing our tin supply, however, is to facilitate the completion of the smelting plants that are being constructed at Perth Amboy and Brooklyn. The urgency of the situation should be pointed out to the Priority Board, to the War Industries Board and to other boards that are interested, and the proprietors of those plants should be aided in every possible way.

At the same time, it should be pointed out to the War Trade Board and to the Shipping Board that tin ore must be brought here from Bolivia with all possible dispatch; such importations should obtain an A1 priority order.

There is no use in wasting much time over prospecting for tin in the United States or in the development of alleged mines. During the last 25 years, private capital has had great inducement to do just this thing and has failed. No Government geologist or mining engineer is going to be able to succeed where private engineers have failed.

However, there is one occurrence of tin in the United States that deserves attention, this being an old mine, abandoned 25 years ago, and now full of water. It is now in the hands of promoters, who have lately been hawking it around in New York. One of our greatest mining companies offered to take it over and put several hundred thousands of dollars into the development, giving the promoters an interest. The promoters stupidly refused to accept this offer, as they were apparently looking for ready money, payment of which, under the circumstances, would be quite unjustifiable. A minerals and metals board might properly look into this situation.

The scarcity of tin in this country at present is something desperate. Price is no object, not even to the Government, which is not keen about price-fixing when there is nobody to bully.

Mr. Hoover has urged the people to dispense with the use of tinfoil and tin plate, and to avoid wastes, but we are unaware of any other officer, board or committee of the Government that has given any serious attention to the tin situation or to means for ameliorating it.

Cost of Producing Copper

THE United States is not the only country in which copper producers must meet rising costs. The recent reports of several of the principal Australian producers disclose figures that are quite in line with those that are being reported in this country. At Mount Lyell for the year ended Sept. 30, 1917, the cost was £53 10s., and this figure is probably lower than that of any other company at present. At the Hampden-Cloncurry mines, according to the chairman of directors, the cost is now about £80, as compared with a pre-war cost of £45 to £50. The Mount Cuthbert, Wallaroo, and Cobar figures are all in the neighborhood of £80 per ton.

Ore and Gangue

THE old question as to the definition of ore and gangue rises once in a while from the past and is likely to entangle some one in its meshes. A short time ago the U. S. Bureau of Mines issued a technical paper of 48 pages entitled "The Ores of Copper, Lead, Gold, and Silver." It is a useful little publication, which can be criticized only on account of its attempt to treat a large subject in too abbreviated a form. Our concern is simply with a brand-new "scientific" explanation of "ore," given after the customary technical definition of the word. It is said that, scientifically speaking, "An ore is a metalliferous mineral that contains a metal that has found a recognized application in the arts and industries, and occurs in such abundance in nature as to be of commercial importance." An inexorable conclusion would seem to be that asbestos, or talc, or kaolin are ores of magnesium and aluminum, or that abrasive garnet is an ore of iron.

Still further complications arise when the author classes auriferous pyrite in which the state of the gold cannot be ascertained as a gangue mineral, or when he labels stibnite in a lead ore with the same appellation, though its antimony may be recovered in the form of hard lead.

The moral is to pass lightly over the troublesome problem of ore and gangue.

BY THE WAY

The fiftieth anniversary of the discovery of the once famous Gympie gold field in Queensland was fittingly commemorated last autumn. James Nash, the discoverer, who reported the find at Maryborough on Oct. 16, 1867, died at Gympie on Oct. 5, 1913, at the age of 79 years. Several years ago a memorial—a drinking fountain—was unveiled on the field and the *Queensland Government Mining Journal* printed an account of the discovery of the gold field by W. H. Traill, from which the following is taken: "It was just at that epoch that, tramping along a bush road, a wandering digger, Nash by name, 'tried a prospect,' as he went, here and there, as a spot seemed likely. There were hundreds of such wanderers plodding along the tracks of the colony, and eking out, with a few grains of gold washed here and a few grains washed there, a sort of subsistence. Nash stopped at an obscure gully on an insignificant cattle run to boil a quart pot of water for his midday meal; and not to waste time, while the water was heating, he stepped up a gully a few paces and tried 'the wash.' What Nash found in his dish when he had washed off the earth may be inferred from the fact that within a few weeks all the distressed male residents of southern Queensland were hastening to the spot, and within six months Australia had assisted to pour 15,000 men on to the field. The gullies were rich and numerous. One ounce of gold to the dish was not uncommon. One Curtis brought to light a nugget weighing 975 oz., and worth £3675. Alluvial gold lying near the surface is not long in being rooted out when 15,000 men are at the task; but about the time when fresh ground became scarce, reefs were discovered as rich in gold as had been the alluvial deposits. Near the surface, when broken into, some of these reefs proved to be of phenomenal richness. The lucky owners picked out buckets full of specimens—fragments of quartz tied and banded together with strings of gold. . . . Within five years, over a million and a half sterling in virgin gold had been extracted from soil and reef. Presently all these splendors were dimmed and a lesson—which should be of transcendent value when applied to other fields in Queensland still in the early stages of development—was taught to miners. The reefs had been found in a black slate, or, more accurately, shale. At comparatively shallow depths, about 200 ft. or so, this rock was succeeded by another quite different. The quartz reefs, on passing out of the black shale into greenstone, became barren. . . . Claims were abandoned in numbers, and there was a prospect of the place being deserted altogether. But deeper sinking by some venturesome spirits cut a second bed of the black shale. The reefs on reëntering it resumed their prolific character. Eventually a second, a third and a fourth bed of the black shale were penetrated, with in most instances a restoration of auriferous character to the reefs when traversing those strata." The Gympie gold field up to the end of 1916 had produced 3,274,797 oz. or approximately $65,000,000. Like other Australian fields its output has been declining of late years; it is now the center of a prosperous farming and grazing district.

Those who are worrying over only one tax return should consider the case of the International Nickel Co., which is three times hit, says the *Evening Sun*. In addition to the American and Canadian excess-profits taxes, the Nickel management has to make allowance for the special Canadian mining tax bill which was passed by the Ontario Legislature last April. Under this law nickel and nickel-copper companies are taxed at the rate of 5% on profits from $10,000 to $5,000,000. It was this multiplicity of taxes that brought about the reduction in the dividend rate on Nickel from 25 to 16% last November. For the nine months ended Dec. 31, 1917, Nickel's gross earnings were $11,797,235 and the net $7,987,967 after setting aside a reserve of $3,680,741. Balance available for common dividends was equal to $3.10 per share ($25 par value), as against $5.94 in 1916. The surplus carried forward for the nine months of 1917 was $2,005,102, compared with $4,933,258 for the corresponding period of the previous year.

America has been a wholesaler in raw materials, writes Secretary Lane of the Department of the Interior in *The Nation's Business*. Our boast has been in the millions of tons of steel or coal or barrels of oil or of feet of lumber that we could produce. We dealt in things of magnitude, that we took greatly as they came out of nature's storehouse, not thinking or not caring how much of any mysterious value they concealed. The chemist finds that nothing is simple. He tears all things apart to find things that are not patent to the eye, and out of the infinitely little and obscure creates a new world of things useful and beautiful. This is the conversion that is going on in America in all fields. We are entering upon the quest for the minor metals, or rarer woods, in our select places of beauty and of exceptional climate or fertility. In all the domain of this great country extending from the semi-tropics across the desert and the most forbidding wastes into the far Arctic we have come to believe that there is no land that is entirely valueless. War forces a nation to an intensive study of what it can do. . . . Men who had regarded themselves as modestly useful only in the discovering and revealing of new sources of material strength found that their years of experience in the mountains and on the desert, in laboratories and in mines, called them at once into the thick of the European struggle. . . . But we soon realize when thrown into such a struggle as this war how far removed from entire independence we are. Coffee, rubber and manganese from Brazil, chrome from South Africa, tea from the Orient, sugar from Cuba, sisal from Mexico, nitrates from Chile, hides and meat from the Argentine, wool from Australia, pyrites from Spain —these are some of the raw materials we need and for which the ocean must be kept open, unless our dependent industries are to weaken.

February Mining Dividends

Dividends paid in February, 1918, by 22 United States mining and metallurgical companies making public reports amount to $12,767,611, as compared with $12,812,268 paid by 25 similar companies in February, 1917. Canadian and Mexican mining companies paid $1,534,963 in February, 1918, as against $2,186,851 in 1917. The only holding company which paid in February was the White Knob Copper and Development Co., which disbursed $10,000, or 5c. a share.

United States Mining and Metallurgical Companies	Situation	Per Share	Total
Am. Zinc, Lead and Sm., pfd	U. S.	$1.50	$144,840
Anaconda, c	Mont.	2.00	4,662,500
Barnes-King, c	Mont.	.10	40,000
Boss, p	Nev.	.03	12,255
Caledonia, l.s	Ida.	.03	78,150
Chief Cons., s.l	Utah	.10	88,422
Cresson, g.s	Colo.	.10	122,000
First Nat. Copper	Calif.	.15	90,000
Golden Cycle, g	Colo.	.03	45,000
Homestake, g	S. D.	.50	125,580
Internat. Nickel, pfd	U.S.-Can.	1.50	133,689
Iron Cap, c	Wash.	.25	36,203
Jim Butler Tonopah, g.s	Nev.	.10	171,802
Miami, c	Ariz.	1.50	1,120,671
Mohawk, c	Mich.	6.00	600,000
New Jersey Zinc	U. S.	4.00	1,400,000
Union Con., g.s	Nev.	.05	200,000
United Eastern, g	Ariz.	.05	68,150
United Verde, c	Ariz.	7.00	2,100,000
West End Con., g.s	Nev.	.10	178,849
United Verde Ex., c	Ariz.	2.25	1,312,500
Western Utah Cop	Utah	.07½	37,000
Canadian and Mexican Companies	**Situation**	**Per Share**	**Total**
Amparo, g.s	Mex.	$0.03	$60,000
Coniagas, s	Ont.	.12½	100,000
Granby Cons., c	B. C.	2.50	374,963
Greene-Cananea, c	Mex.	2.00	1,000,000

Dividends were passed this month by the Wilbert and Hecla companies.

Total dividends in the first two months of the year were as follows, the figures for 1917 being given in parentheses: United States mining and metallurgical companies, $20,211,013 ($26,272,734); holding companies, $330,000 ($1,340,000); Canadian, Mexican and Central American companies, $2,714,261 ($3,826,199).

Engineers on the Mesabi Remember the Twenty-Seventh

Of course, Hoover was unable to be present, or they would have been more careful with the $C_{12}H_{22}O_{11}$. But people accustomed to do things in a large way, as they are up on the Mesabi range where this happened, are apt to be careless about small matters. It was at the banquet of the Engineers' Club of Northern Minnesota, and after reading a telegram from absent members serving in the 27th Engineers, President A. E. Anderson suggested a donation to the Comfort Fund, as the best way of backing their friends in the mining regiment. So they dumped the sugar from the bowls and took up a collection. And we bet that they will remember the banquet longer because of this event, and so will we.

The mining regiment needs more recruits. Mine managers all over the country are requested to interest themselves in filling up the ranks. We suggest that notices be posted at all mines that persons desiring to volunteer should communicate with the mine management, which will advise respecting the proper procedure for enrollment in the 27th Regiment of Engineers. The regiment has been equipped with rifles, has become proficient in the manual of arms and exhibits all the appearances of a well-trained regiment. "A" Company is provided with mining tools, portable machinery, etc., in a way that's considered superior even by veterans from abroad. Uncle Sam pays the bill for all this. But the little things, such as tobacco, games and athletic equipment, that will help the men enjoy life, must be purchased either by the men themselves or out of the Comfort Fund. Put yourself in the place of any man in the regiment, and see what an attractive thing the fund is. Consider the matter from this angle and then get your name on the following list of contributors:

Engineering and Mining Journal	$1000.00
New York Engineering Co.	1000.00
A Friend, Nov. 23	5.00
H. H.	5.00
D. E. Charlton	5.00
H. W. Hardinge	1000.00
Frank N. Spencer	5.00
W. L. Coursen	5.00
J. H. Polhemus	5.00
J. H. Janeway	10.00
Albert D. Beers	10.00
J. E. Hayes	10.00
J. A. Van Mater	25.00
L. Vogelstein & Co.	100.00
"Cuprite"	10.00
R. H. Bassett (Hanna Ore Mining Co.)	10.00
A Friend, Dec. 10	10.00
P. A. Mosman	10.00
American Zinc, Lead and Smelting Co.	100.00
J. G. H.	5.00
Daniel Guggenheim	100.00
A. H. H.	5.00
Willard S. Morse	25.00
August Heckscher	100.00
Anaconda Copper Mining Co.	1000.00
F. W. Bradley	100.00
Charles Le Vasseur	5.00
A Friend, Dec. 13	50.00
Freeland Jewett	10.00
Herman A. Wagner	5.00
Francis P. Sinn	10.00
R. C. Gosrow	5.00
D. C. Jackling	100.00
"V"	10.00
J. H. Brickenstein	5.00
E. E. Northrup	5.00
Rogers, Mayer & Ball	50.00
Denver Technical Staff, American Metal Co., Ltd.	30.00
A Friend, Jan. 9	100.00
E. B. Coolidge	10.00
J. V. N. Dorr	200.00
Pope Yeatman	50.00
W. H. Aldridge	50.00
C. E. Hart	5.00
Robert I. Kerr	5.00
Engineers of Washoe Smeltery, Anaconda Copper Mining Company	205.00
Harry C. Graham	25.00
Utah Copper, Nevada Consolidated, Ray Consolidated and Chino copper companies	1000.00
A Friend, Jan. 23	5.00
John Gillie	25.00
J. N. Houser	5.00
C. K. Lipman	50.00
Theodore Sternfeld	50.00
Clinton H. Crane	500.00
T. Wolfson	10.00
William H. Hampton	10.00
W. E. Merriss	10.00
J. Parke Channing	100.00
Miami Copper Co.	250.00
J. H. Means	10.00
C. W. Goodale	25.00
P. G. Beckett	50.00
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Utilization of Norway's Iron Ores

The Norway iron and steel industry is showing activity, and no less than five different new companies now contemplate the working of the iron and steel in various ways, according to *Commerce Reports*. The largest of these is the Christiania Staalverk. This company has actually been in existence for about 30 years, having been originally incorporated with a capital of $8000. At present it manufactures a small quantity of steel from imported pig iron, and it has been gradually increasing its capital up to $268,000. It now desires to bring the capital up to about $6,000,000, with the idea of smelting ores and making steel and rolling plates and shapes to the extent of about 50,000 tons per year. The extension of the company is being encouraged by the government, which offers to guarantee a loan of $2,742,000, to be repaid during 40 years. The government also grants a subsidy of $1.61 per metric ton of all rolled products turned out during the first five years of operations, and gives certain water-power concessions, which will enable the company cheaply to develop the power of waterfalls which are about 18 miles from Christiania.

Electrochemical Works at Shawinigan

The electrochemical industries in the Shawinigan district of Quebec, Canada, are described in a paper by H. E. Randall, presented at the Pittsburgh meeting of the American Electrochemical Society in October, 1917. In this district, which is situated 20 miles from tidewater on the St. Lawrence River, 500,000 hp. has been installed and 600,000 available water-power is as yet untouched. The Pittsburgh Reduction Co., now the Northern Aluminum Co., was one of the first industries to locate at Shawinigan. American refined bauxite is brought in by rail and reduced to aluminum, between 50,000 and 60,000 hp. being used for this purpose. The Aluminum Co. also has a wire-drawing and cabling plant, and manufacture all the aluminum wire made in Canada. The works employ about 500 men.

The Canada Carbide Co. employs about 350 men, manufactures calcium carbide and acetylene gas only, and utilizes some 40,000 hp. The Shawinigan Electro-Metals Co. produces metallic magnesium in many forms, and occupies about five acres with various processes. The company utilizes about 2500 hp. in both alternating- and direct-current furnaces. The Canadian Electrode Co. manufactures the larger sizes of carbon electrodes, and has an output of about 15 tons per day.

The Canadian Electro-Products Co. manufactures acetic acid and acetone from acetylene gas supplied by the Canada Carbide Co. This plant has been put into operation since the war, and has become one of the large industries at Shawinigan. The Prest-O-Lite Co. operates a compressing plant for acetylene gas which it purchases from the Canada Carbide Co. and which is distributed as dissolved acetylene by the company. Fraser, Brace & Co. have an experimental electric furnace plant for the manufacture of various kinds of steels and for general experimental purposes. The latest addition to Shawinigan power users is the Canadian Aloxite Co., a subsidiary of the Carborundum Co., which will utilize over 20,000 hp. and is building an extensive plant covering about 15 acres.

Tungstenite, a Sulphide of Tungsten

Discovery of a sulphide of tungsten, the first to be found as a mineral, has been made in the Emma mine, in the Little Cottonwood district, Utah. The new mineral, which has been named tungstenite, is described in a preliminary way by R. C. Wells and B. S. Butler, of the U. S. Geological Survey, in the *Journal* of the Washington Academy of Sciences, as follows:

"The hardness of tungstenite appears to be about 2.5. Particles which are easily cut from the massive piece with a knife blade appear under the microscope to consist of feathery leaves or flakes resembling graphite. The mineral is opaque. It marks paper, soils the fingers slightly, and rubs up between a mortar and pestle like graphite. The cleavage and fracture could not be determined. The luster varies from dull to brilliant metallic; the color is dark lead gray, and the streak is dark gray. The actual specific gravity of the second specimen mentioned was 6.43. Allowing as well as possible for the impurities and undetermined material, the specific gravity of the tungstenite is calculated to be about 7.4. This may be compared with the following specific gravities, MoS_2, 4.7; FeS_2 4.9; MoO_3, 4.5 and WO_3, 6.3.

"Tungstenite appears to be unattacked by hydrochloric acid or nitric acid. It is decomposed by aqua regia or by fusion with sodium nitrate. Its behavior in a bulb tube and on charcoal cannot be stated definitely because of the impurities, though it appears to be a rather stable compound, not even being oxidized by roasting in air. It burns with incandescence in oxygen."

United States Using Less British Tin

Imports of tin into the United States during the calendar year 1917 showed a slight increase, notwithstanding the difficulties experienced by American importers in getting foreign export licenses and the fact that the importation of this metal is controlled by the U. S. Government. Including the approximate content of imported ore, but not including Alaskan ore, the total imports of tin in 1917 amounted to 68,996 long tons, against 66,624 tons in 1916, according to figures made public on Feb. 14 by the Bureau of Foreign and Domestic Commerce, Department of Commerce.

Of 1916 imports, 49,415 tons, or 74% of the total, came from England and the Straits Settlements, whereas in 1917 only 41,463 tons, or 60%, came from these two sources. Imports from the Dutch East Indies increased to 14,148 tons, or 20% of the total, Australia, China, and Bolivia supplying most of the remaining 20%. A large part of our Straits tin imports came by way of England, as usual, but it is expected that 1918 will witness an increase in direct shipments.

The Mining Index

This index is a convenient reference to the current literature of mining and metallurgy published in all of the important periodicals of the world. We will furnish a copy of any article (if in print) in the original language for the price quoted. Where no price is quoted the cost is unknown. Inasmuch as the papers must be ordered from the publishers, there will be some delay for the foreign papers. Remittance must be sent with order. Coupons are furnished at the following prices: 20c. each, six for $1, 33 for $5, and 100 for $15. When remittances are made in even dollars, we will return the excess over an order in coupons if so requested.

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8908—POTASH—Alunite Deposits of Australia and Their Utilization. (Bull. 3, Australia Advisory Council of Science and Industry, 1917, 47 pp., illus.) Report of a special committee appointed to investigate the Australian deposits of alunite and their suitability for the production of potash.

MISCELLANEOUS

8909—ALASKA—Government Railroad of Alaska. Theodore Pilger. (Min. and Sci. Press, Dec. 29, 1917; 7¼ pp., illus.) 20c.

8910—DEPLETION AND DEPRECIATION. T. O. McGrath. (Eng. and Min. Journ., Jan. 26, 1918; 2½ pp.) 20c.

8911—LABOR—The Engineer, the Cripple and the New Education. Frank B. and L. M. Gilbreth. (A.S.M.E., Dec., 1917; 13 pp.)

8912—LABOR—The Problem of Industrial Housing. Leslie H. Allen. (Ind. Management, Dec., 1917; 9 pp., illus.; also Iron Age, Dec. 27, 1917.) 40c.

8913—PROFESSIONAL FEES and Their Collection. Frederick F. Sharpless. (Eng. and Min. Journ., Jan. 26, 1918; 1¾ pp.) 20c.

8914—RUSSIA—The New Russia. Wm. B. Thompson. (Eng. and Min. Journ., Feb. 2, 1918; 2¼ pp.) 20c. A speech at the dinner of the Rocky Mountain Club, Jan. 23, 1918.

8915—TAX—Federal Income Tax on Mines. (Eng. and Min. Journ., Feb. 9, 1918; 1 p.) 20c.

8916—WAR—Organization of War Department and War Industries Board. (Eng. and Min. Journ., Feb. 9, 1918; 1¾ pp., illus.) 20c.

8917—WAR—Organizing Industrially for War. C. E. Knoeppel and G. Sumner Small. (Ind. Management, Dec., 1917; 9½ pp.)

8918—WORKMEN'S COMPENSATIONS. J. Preston Jones. (Bull. 44, Univ. of Ariz., Bureau of Mines, 1916-17; 19 pp.)

Personals

Have you contributed to the Association for the 27th Engineers?

C. M. Weld, of New York, is in Cuba.

W. M. Drury has returned to El Paso, Tex., from an extended trip to various properties in Mexico.

Henry U. Birdseye has been elected second vice president of the Detroit Graphite Co., Detroit, Michigan.

R. H. Patterson has been appointed manager of the Gold Pan mine, in the Rice Lake gold district of Manitoba.

L. B. Harrison, superintendent of the Monterey plant of the American Smelting and Refining Co., is in San Antonio, Tex.

Rush M. Hess is making manganese investigations and examinations in the southeastern states, with headquarters at Anniston, Alabama.

Irving S. McReavy, manager of the Trethewey mine, Cobalt, Ont., succeeds **J. W. Moffett** as general manager of the Temiskaming Mining Co., Ltd.

Messrs. Knox and Allen announce the removal of their New York offices on Mar. 1 to 17 Madison Ave. (Madison Square, East), telephone Madison Square, 7327.

R. E. Adams has returned to El Paso, Tex., from Matehuala, San Luis Potosi, Mex., where he had relieved **E. E. Reyer,** who was in the United States on a vacation.

I. F. Laucks, formerly of Falkenburg & Laucks, which partnership was recently dissolved, has opened chemical assay and metallurgical laboratories at 99 Marion St., Seattle, Washington.

J. B. Johnson has resigned as chief engineer of the Arizona Copper Co., at Clifton, Ariz., to accept the position of mechanical engineer with the United Verde Copper Co., at Clarkdale, Arizona.

Robert E. Dye, who was for several years superintendent of the Buffalo mill at Cobalt, Ont., has been appointed manager of the Teck-Hughes Gold Mines, Ltd., Kirkland Lake, replacing **L. W. Ledyard.**

T. A. O'Donnell, of Los Angeles, Calif., who has been prominent in the development of Western oil properties, has been appointed an aid of Mark L. Requa, head of the oil division of the U. S. Fuel Administration. Mr. O'Donnell will have charge of the oil production problem.

Col. William B. Thompson is the donor of a new gymnasium, costing $200,000, to Phillips Exeter Academy, at Exeter, N. H. The dedication of the gymnasium took place at the Washington Birthday celebration. Col. Thompson is a graduate of the Academy of the class of 1890.

Pope Yeatman has been placed in charge of the nonferrous metals department of the raw materials division of the War Industries Board, succeeding Eugene Meyer, Jr. Mr. Meyer remains as a member of the raw materials division but has undertaken some special work for Secretary Baker.

W. S. Boyd, formerly superintendent of mines of the Ray Consolidated Copper Co., has been appointed assistant general manager; he is succeeded as mine superintendent by **G. A. Smith,** formerly assistant superintendent. **E. A. Thornton,** chief engineer, has been made assistant superintendent, **R. W. Thomas** becoming chief engineer. **E. J. McCafferty,** foreman of No. 2 mine, has been made general foreman of mines.

There is a vacancy in a junior position on the editorial staff of the Engineering and Mining Journal, which is open to a young engineer of distinctly metallurgical education and experience. Applicants should address us in their own handwriting, stating their experience and giving their references. Preferential consideration will be given to those who are able to call in person, but nobody should call without previously making application in writing and awaiting an appointment.

Obituary

Capt. Charles Fabre, a pioneer of '49, died at San Rafael, Calif., on Jan. 30, aged 88 years. Capt. Fabre sailed from France in his own ship, rounding the Horn and arriving in California in 1849. He sold cargo and ship and entered the mines. He was known along the coast from Alaska to Mexico for having won and lost several fortunes in mining and over the gambling tables.

Societies

American Concrete Institute has postponed its annual convention from Feb. 7-9 until June.

New York Sections of the American Electrochemical Society, the American Chemical Society and the Society of Chemical Industries held a meeting in Rumford Hall, Chemists' Club, 52 East 41st St., New York, on Mar. 1, at 8:15 p.m. Dr. Henry K. Richardson, who has spent several years in China, talked on "A Chemist's View of the Native Industries in China." He spoke principally of the ancient industries and illustrated his talk with 70 lantern slides.

Chemical Alliance, Inc., held its first annual meeting at the Biltmore Hotel, New York, on Feb. 6. About 125 were in attendance, and practically every branch of the chemical manufacturing industry was represented. Applications for membership number 180 and more are coming in. Committees representing the different branches of the chemical industry were formed; officers, board of directors, and chairmen of the committees were elected. The latter constitute the board of directors, who have the privilege of electing five additional directors at large. Following are the officers and committees selected: President, Horace Bowker; vice president, Henry Howard; secretary-treasurer, J. D. Cameron Bradley; directors at large: Edward Mallinckrodt, Jr., E. R. Grasselli, Dr. William H. Nichols, William Hamlin Childs, and J. J. Riker. Committees: Acid Section: W. D. Huntington, chairman, S. B. Fleming, J. M. Goetchius, C. F. Burroughs, J. H. D. Rodier, Charles M. Butterworth; Coal Tar By-products Section: D. W. Jayne, chairman, W. R. Addicks, C. J. Ramsburg, W. E. McKay, A. A. Schlesinger; Foreign Pyrites Section: A. D. Ledoux, chairman, C. F. Burroughs, F. H. Nichols, W. H. Mills; Electro Chemicals Section: F. A. Lidbury, chairman, C. D. Cohen, F. J. Tone; Fertilizer Section: C. G. Wilson, chairman, C. F. Burroughs, W. D. Huntington, C. H. MacDowell, A. C. Read, Albert French, Porter Fleming, William Prescott, Frederick Rayfield; Miscellaneous Chemicals Section: A. G. Rosengarten, chairman, G. P. Adamson, William Henry Bower; Alkali Section: J. D. Pennock, chairman, E. H. Hooker, N. E. Bartlett, E. Sargent, Eli Winkler; Domestic Pyrites and Sulphur Section: C. H. MacDowell, chairman, W. N. Wilkinson, H. P. Nash, C. G. Wilson; and Dyestuffs Section: Dr. C. L. Reese, chairman; and Dr. J. M. Matthews, secretary.

Industrial News

Hyatt Roller Bearing Co., Newark, N. J., has promoted Earl E. Eby to be assistant sales manager. Mr. Eby, who was formerly manager of the Pittsburgh office of the industrial bearings division of the company, will be stationed in the Metropolitan Bldg., New York.

Walter A. Zelnicker Supply Co., St. Louis, has established permanent offices at 627 Plymouth Bldg., Minneapolis, Minn., to serve the north central and Canadian trade. Richard K. Papin, formerly St. Louis and southwestern representative of the Davenport Locomotive Works and for 10 years manager of the Zelnicker company's equipment department, is in charge.

Vulcan Steel Products Co.'s representative in Paris, George S. Thompson, was recently appointed to the purchasing board of the American Expeditionary Forces in France, and has been assigned particularly to the handling of steel matters. This board is composed of American civilians living in France, headed by Major Drake, and its duty is to pass upon all purchases made in Europe by the American Army. Among other members of the board are representatives of Armour & Co., Baldwin Locomotive Works, Standard Steel Car Co., American International Corporation, Vacuum Oil Co., United States Steel Products Co., Borgfelt & Co., Allied Machinery Co., and the United States Rubber Company.

Trade Catalogs

Brownhoist Buckets and Tubs. The Brown Hoisting Machinery Co., Cleveland, Ohio. Catalog E. Pp. 64; 6 x 9-in.; illustrated. Tables of sizes and capacities of the different types of buckets are given.

"Steelcrete" Products, Consolidated Expanded Metal Companies, Braddock, Penn. Pp. 12; 6 x 9 in.; illustrated. A booklet, entitled "Military Camps of Our Allies" and designed to portray the uses of "Steelcrete" products in building construction.

"The Evolution of the Steel Ball Industry" is the title of a pamphlet issued by the Hoover Steel Ball Co., Ann Arbor, Mich., which tells in an interesting way how the steel ball industry came into existence and describes the methods of manufacture. Pp. 116; 6 x 9-in.; illustrated.

New Patents

United States patent specifications listed below may be obtained from "The Engineering and Mining Journal" at 25c. each. British patents are supplied at 40c. each.

Alumina, Purification of. John W. Hornsey, Summit, N. J., assignor to Mineral Products Corporation, New York, N. Y. (U. S. No. 1,255,749; Feb. 5, 1918.)

Core-Drill. Rowland O. Pickin, Chicago, Ill. (U. S. No. 1,254,268; Jan. 22, 1918.)

Electrolytic Apparatus having Rotating Receptacle for Electrolyte. James T. King, Toronto, Ontario, Canada. (U. S. No. 1,254,045; Jan. 22, 1918.)

Electrodeposition of Metals. Frederick Laist and James Orr Elton, Anaconda, Mont., assignors to Anaconda Copper Mining Co., Anaconda, Mont. (U. S. No. 1,255,432; Feb. 5, 1918.)

Furnace, Electric. Frederick T. Snyder, Oak Park, Ill. (U. S. No. 1,254,077; Jan. 22, 1918.)

Furnace — Electric Smelting Furnace. Frederick T. Snyder, Oak Park, Ill. (U. S. No. 1,254,079; Jan. 22, 1918.)

Furnace—Metallurgical Furnace (Electric). William Buhl, Carnegie, Penn. (U. S. No. 1,254,308; Jan. 22, 1918.)

Glauconite—Process for Extracting Potassium Salts from Glauconite or Green Sand. Frederick Tschirner, Newark, N. J. (U. S. No. 1,254,450; Jan. 22, 1918, and No. 1,254,451; Jan. 22, 1918.)

Gold-Recovery Device (a sluice). George M. Minkler, Spokane, Wash. (U. S. No. 1,254,718; Jan. 29, 1918.)

Mine Car—Tilting Platform for Mine Car Dumps. James A. Nolan, Bowerston, Ohio. (U. S. No. 1,254,621; Jan. 22, 1918.)

Mine Car—Control Mechanism for Automatic Safety Mine Car Cagers. James A. Nolan, Bowerston, Ohio. (U. S. No. 1,254,622; Jan. 22, 1918.)

Mine-Car Wheel. Thomas Parker Otterson, Krebs, Okla., assignor of one-half to Presley Robins Allen, McAlester, Okla. (U. S. 1,255,780; Feb. 5, 1918.)

Ore-Separator. Charles E. Brown, Lawton, Okla. (U. S. No. 1,254,651; Jan. 29, 1918.)

Ore Treament—Process of Treating Complex Ores or Concentrates Therefrom. Frederick Laist, Anaconda, Mont., assignor to Anaconda Copper Mining Co., Anaconda, Mont. (U. S. No. 1,255,440; Feb. 5, 1918.)

Rock Drill—Close-Corner Drill. Francis A. Jimerson, Athens, Penn., assignor to Ingersoll-Rand Co., Jersey City, N. J. (U. S. No. 1,255,316; Feb. 5, 1918.)

Steel—Process of Producing Iron and Steel. Samuel McDonald, Alhambra, Calif. (U. S. No. 1,255,191; Feb. 5, 1918.)

Tunneling—Means for Forming Circular Tunneling by positioning concentric spaced rings transversely in tunnel, driving lagging boards between said rings, removing the dirt in the space inclosed by the lagging boards, positioning a second pair of circular rings, etc. John W. Morgan, Milwaukee, Wis. (U. S. No. 1,255,207; Feb. 5, 1918.)

Zinc—Method of Purifying Zinc-Bearing Solutions. Frederick Laist and James Orr Elton, Anaconda, Mont., assignors to Anaconda Copper Mining Co., Anaconda, Mont. (U. S. Nos. 1,255,434; 1,255,435; Feb. 5, 1918.)

Zinc—Process of Recovering Zinc from Ores. Frederick Laist and James Orr Elton, Anaconda, Mont., assignors to Anaconda Copper Mining Co., Anaconda, Mont. (U. S. Nos. 1,255,436; 1,255,439; Feb. 5, 1918.)

Zinc—Process of Treating Zinc Ores Containing Iron by Calcining, Etc. Frederick Laist, Anaconda, Mont., assignor to Anaconda Copper Mining Co., Anaconda, Mont. (U. S. No. 1,255,438; Feb. 5, 1918.)

Zinc—Recovering Zinc From Its Solutions by Electrolysis. Frederick Laist and James Orr Alton, Anaconda, Mont., assignors to Anaconda Copper Mining Co., Anaconda, Mont. (U. S. No. 1,255,433; Feb. 5, 1918.)

Editorial Correspondence

SAN FRANCISCO—Feb. 20

Waste Rock from the Black Oak Mine dump in Tuolumne County is providing fine road metal which is being used by the county. Two miles of road has been surfaced with this material; and all that is needed to reduce the waste dumps of the mines to good road metal is a rock crusher. So there is no excuse for many bad roads in the mining districts of the state. The cost of the material is small. In fact, many of the mines are ready to donate the waste for road-making purposes. The fault lies with the supervisors of the counties, who are responsible for the roads. Incidentally, the fault also lies with the mining companies, who do not make it a part of their business to demand good roads.

Ninety-five New Oil Wells were started in the first six weeks of 1918 in California fields. The number in the first week of February was only nine, which was much below the average. In the week ended Feb. 2 the number was 21 and for Jan. 26 it was 12. The total of 95 is an increase of only two wells over the same period of 1917. The new wells in the present period are evenly distributed over the fields including Los Angeles, Santa Maria, Kern County and Coalinga. One of the notable new wells, reported by the State Mining Bureau in the last report is by the Shell Co. in the Montebello field. A new well by the New Mexico Oil Co. in Ventura County calls attention to undrilled territory south of Sulphur Mountain, where recent development has indicated production at shallow depth. There were only two wells abandoned in the week, making a total of seven abandoned since the beginning of the year.

Production of Zinc in Shasta County in 1916 amounted to 9,484,800 lb., an increase of 1,106,399 lb. over 1915. This production came chiefly from the Mammoth mines. The source of the Mammoth production in 1915-1916 was the jig-concentration of copper ores carrying a zinc content. The new electrolytic zinc plant at Kennett, installed in 1916, passed through the experimental stage in the last half of the year, and in 1918 will add largely to the zinc product. The plant is operated on the baghouse product of the copper smeltery, which contains zinc in the form of sulphates and oxides from the copper ores. The Afterthought flotation plant should also add largely to the zinc output of Shasta County in the present year, as the experiments have been practically completed. The Pacific Coast offers a spelter market at a price about 1½c. per lb. higher than the markets of New York and St. Louis and the consumption of zinc in the coast region is many times greater than the present output. There are other zinc-bearing ores in the county, notably at Bully Hill, which have remained undeveloped during a long period of years because of the lack of metallurgical methods to meet the requirements and of a profitable market for zinc. Shasta County has long been the chief copper producer in California and ranks high as a gold producer. The total production of all minerals in the county in 1916 was valued at $13,639,508. Of this amount the gold and silver product totaled $2,052,356.

The 319th Engineers, now being organized at Camp Fremont, Palo Alto, Calif., is asking through the press of the state for the enlistment of miners between the ages of 18 and 40, inclusive. The regiment will probably be employed largely in that class of work for which good miners are trained. Men subject to draft may be inducted into this regiment, and those not subject to draft who are within the age limits may enlist. This offers a fine field for miners and other skilled workmen and engineers to serve the nation in the way that will be of greatest advantage to the country and most satisfactory to themselves. It is stated by J. A. Dorst that this may be the last opportunity to be offered for men to take service in this regiment without being drafted. The list of trades desirable is given by Major Dorst in circulars sent out. Draftsmen, instrumental surveyors, adzemen, topographical sketchers, carpenters, skilled and rough; photographers or blueprint operators, blacksmiths, pipefitters, mine timber men, plumbers, trackworkers, sign painters, men specially trained in signaling (this can be done after the men join), men specially trained in reinforced concrete, packers (muleteers), machinists, motorcar and motorcycle drivers, saddlers, cable- and rope-splicers, farriers, powder and demolition men, riggers, cobblers, buglers, horseshoer, wagoners 9 (drivers), masons, company clerks (stenographers), cooks (these are important), electricians (linemen or engineers), assistant supply clerk (shipping clerk), barbers, bricklayers. It is probable, the circular states, there will be use for men having experience with locomotive, steam, oil and gas engines and almost anything in the mechanical and construction lines. Men without training, but capable, will also be acceptable.

SALT LAKE CITY—Feb. 20

Utah as a Producer of Silver in 1917 stands first in the list of states producing this metal, according to the Bureau of Mines and U. S. Geological Survey. The output of this state amounted to 14,315,300 oz., valued at $11,788,700. The gold production, amounting to 175,133 oz. and valued at $3,620,300, places Utah eighth in the list of gold-producing states.

Non-Resident Employees at the Garfield Plants of the Utah Copper Co., numbering about 157, who were laid off for failure to report for duty on the morning of the 10th, are again at work. The men had no grievance against the company, and their action in not reporting for work was apparently undertaken under sudden impulse, is said to have been due to dissatisfaction with the train service from Salt Lake City to Garfield, particularly in the matter of morning trains. No further trouble is expected. An agreement reached in conference between the company management and representatives of the employees was unanimously accepted at a meeting held at the Labor Temple on the evening of Feb. 14. The question of the train schedule as asked for by the men is before the state utilities commission.

BUTTE, MONT.—Feb. 23

The Rustling Card System is being investigated by Paul A. Brissenden, of Washington, D. C., who is connected with the Bureau of Labor Statistics. About the only persons who are opposed to the rustling card system are the I. W. W., and they have interested Congresswoman Jeannette Rankin in their behalf, and it was through her efforts that Brissenden came to Butte. Any man who bears a decent reputation can secure a rustling card. The card is issued at the employment offices of the mining companies and can easily be obtained by any man who can show that he is a bona fide workman who was not discharged from his last place of employment for conduct detrimental to the best interests of his employer. Brissenden will report to the Bureau of Labor in Washington. He has had a conference with some members of the Industrial Workers of the World.

Montana State Employers' Association adjusted 240 differences between employers and employees in Butte in 1917 in conferences between representatives of organized labor and this association. Corresponding numbers of differences were adjusted in many other cities of Montana in which the organization is represented. This goes to show what can be accomplished by systematic, collective and sympathetic action on the part of both employers and employees, which tends to bring out the point of view of each and to be conducive to an agreement that is mutually just and satisfactory. Formerly adjustments have usually been preceded by strikes, lockouts, expensive interruption to the industries, court proceedings and the like that resulted merely in a temporary compromise and in the widening of the gap between the interests of labor and capital. To create a better understanding between employer and employee it became necessary to eliminate the custom of the employer dealing as an individual with labor as an organization, a necessity that found expression in the formation of the Montana State Employers' Association, which is proving itself to be the strongest and most constructive organization of business men in Montana. It has attracted the notice of the United States Department of Labor, which is now considering a national plan of arbitration based on the general principles as worked out by the employers of Montana.

The Legislature is in Special Session, and the radical element of the labor party is active in an effort to prevent the passage of a law which will enable the authorities more effectually to deal with the class of people who will not work themselves or let anyone else work. The socialists and I. W. W. have joined hands with what is known as the non-partisan league, and with a big lobby in attendance at the capitol money is being freely spent in behalf of the agitators to stop all legislation. The non-partisan party, so called, is working among the farmers and soliciting their support in the effort being made to defeat the law proposed by Governor S. V. Stewart to give additional powers to the authorities to protect the law-abiding people from the depredations of the I. W. W. Among some of the labor organizations whose membership is mostly composed of the radical element, meetings have already been held for the purpose of securing aid for the miners' I. W. W. union, when a demand is to be made, about April 1, for more wages, fewer working hours and other radical concessions. The demand is to be for $6 a day, six hours' work and the abolishment of the rustling-card system. So far the only organization which has shown any inclination to come to the support of the I. W. W. is the electricians' union. This organization has few conservative men in its ranks, and its members are almost continually endeavoring to make trouble.

SPOKANE, WASH.—Feb. 20

New Charges for Treatment as announced by the Consolidated Mining and Smelting Co. of Canada, Ltd., are giving operators in British Columbia considerable concern. These charges provide for a payment on ore containing not more than 4% zinc, of 95% of the silver content and 90% of the lead content. With each increase of 1% of zinc content the company will reduce the amount of the silver it will pay for by 0.5%, and it will reduce the amount of lead it will pay for by 1%. Ore containing more than 25% zinc will not be accepted. If the ore contains more than 0.05 oz. in gold 95% of the gold will be paid for at $20 per oz. An additional charge of 50c. per unit per dry ton of material, but not to exceed $4 a ton, will be made for sulphur in the ore. A minimum deduction of 0.25% will be made for moisture. Flotation concentrates will be charged $1 extra per dry ton. Charges for smelting will be increased or decreased 25c. a ton whenever the cost of coke increases or decreases. The charges will be increased or decreased 1½c. per ton for each 1c. increase or decrease of change per shift in the wages paid labor.

WALLACE, IDAHO—Feb. 21

The Idaho School of Mines, at Moscow, will adapt its courses to the exigencies of war. In making the announcement Francis A. Thomson, dean of the school, says: "All of our sophomores and juniors are 'off to the war,' and we have but one senior left, and he has already enlisted and awaits his call to the aviation camp. We have a large and vigorous freshman class, and the problem is how shall we train these men that they may be of the greatest possible service." Prof. Thomson says it will be necessary to maintain the four years' course, but the number in the class will be small. The school of mines is already pledged to assist the War Department in selecting men for special service in the Army, and the dean thinks the situation will best be met by the adoption of a technical vocational course of six or twelve months to prepare young fellows just out of high school for substitutes in industry to take the places of technical men, practically all of whom are now in France or on the way there. "We propose, therefore," continues Prof. Thomson, "to give to these

men, and to any other high-school graduates who may care to enter, an intensive course in geology, mineralogy, fire and wet assaying and mine surveying. We shall have to waive some prerequisites, but at the same time subjects taken will count toward the degree course when the war is over. The work to some extent will have to be of an empirical character and the course will be entirely unconventional, but what of that if by this means we can be of service to the state, to the nation and to the cause of democracy? It is frankly a war-emergency measure, and like many such will doubtless furnish partial precedent for procedure in peace."

A Scholarship in the Idaho School of Mines has been established by Jerome J. Day, open to the competition of the pupils of the high schools of Shoshone County. Mr. Day amassed a fortune in this county through his interest in the Hercules mine, and he holds other large mining interests here in association with his brothers. He is president and general manager of the Tamarack and Custer mine and president of the Northport smeltery. Mr. Day disclaims any philanthropic motives in announcing this scholarship, but states that his purpose is to encourage young men to take a mining course to meet the growing demand for technical men in all branches of the mining industry. The scholarship provides for $250 a year, so at the end of four years Mr. Day will be contributing $1000 a year toward the education of young men from this county.

DULUTH, MINN.—Feb. 23

Duluth, Missabe & Northwestern Dock No. 6, costing $2,500,000, it is hoped will be ready for handling ore soon after the opening of navigation, as only 200 ft. of dock remain to be constructed. Although handicapped in getting materials, the work is being pushed rapidly, as sufficient steel is arriving to keep the crews working. Some of the machinery to be installed has not yet arrived. New approaches are being built to ore docks Nos. 3 and 4. Timber is being used in this reconstruction, rather than steel, due to the large demand for steel for war purposes.

It Was Hoped that 70,000,000 Tons of ore might be shipped from Minnesota during the 1918 season, but it is feared that this cannot be done, since the Government has commandeered 11 vessels. Even if it could be moved to the lower Lakes, it is not thought that the furnaces have the capacity to handle such a quantity. More developing and more stockpiling is being done now than ever before. Throughout the winter shipments have been made by rail to the Minnesota Steel Co. and the Zenith Furnace Co. at Duluth. Shipments are also being made to Chicago and other points.

JOPLIN, MO.—Feb. 20

Zinc Ore Found at Postal, Mo., in a bed of blue limestone is said to contain high-grade ore of exceptional purity. Development will be started by the Zinc Hill Mining Co. The deposit occurs on the 600-acre farm of C. J. Schacelford near Postal, 200 acres lying in Pettis County and 400 acres in Cooper County. Mining machinery is being set up and a 7 x 10-ft. shaft is being sunk. A mill having a capacity of 150 tons per 8 hours will be erected. The zinc is disseminated in blue limestone.

An Amendment to the Excess Profits Tax provisions of the war-revenue law is being discussed in this district in an effort to arouse interest in the necessity for help in this matter. The committee that has been in Washington for several weeks for this purpose returned recently and during the last week operators and producers were addressed at Picher, Okla., and Webb City, Mo., by Victor Rakowsky and L. C. Church, of Joplin, members of the committee. Subcommittees have been appointed, and an effort will be made to raise a fund of not less than $20,000 to keep a committee or representative at Washington until the matter is thrashed out. Possibly a representative will be kept in Washington permanently. Part of the work here is to get every man who has any influence with any member of Congress to exert that influence immediately in the interest of the amendment. It is believed that were it not for the extraordinary conditions the amendment would not be difficult to obtain, but there are so many things for the Government to do that only extra effort will bring success in this case. Committees have been appointed to prepare statistics from the three important centers in this field, Joplin, Webb City and Miami, proving the unfairness of the present tax.

TORONTO—Feb. 21

Second Annual Report of the Hollinger Consolidated, being the seventh annual report of the Hollinger Gold Mines, Ltd., for the year ended Dec. 31st, shows that operations have resulted in the wiping out of the deficit of $269,500; the accumulation of a surplus of $712,724; the disbursement of $738,000 in dividends and the expenditure of $673,237 upon plant and $131,224 upon capital development. The total income was $4,271,260, with a gross operating profit of $2,009,549 and a net profit, after deducting depreciation, taxes and donations, of $1,720,314. President N. G. Timmins, in his report, states that, although in the mine over 508,000 tons of ore, carrying $4,373,635, were removed, an increase is shown in ore reserves from $34,185,536 to $40,231,435, meaning that approximately $10,300,000 of new ore has been exposed during the year. For two years work below 800 ft. has been practically at a standstill, while over $10,000,000 of the new ore has been developed above the 800-ft. level, the ground below that depth being unexplored territory of good speculative value. The curtailment of dividends early in 1917 enabled the company to be placed upon its present strong basis. The conviction was expressed that conditions would eventually become more favorable to the gold-mining industry. The future policy of the company would be to conserve its strength until it was possible to see into the future more clearly than at present. If conditions become no worse the early resumption of dividends may be looked forward to. The report of Managing Director P. A. Robbins states that an average number of 1045 men were employed during the year, which had increased to 1230 men at the end of the year. The value per ton of the ore reserves is estimated at $8.95, against $8.68 estimated at the end of 1916. The mill operated at reduced capacity, owing to labor shortage, the actual time of operation being 70.2% of possible, as against 91.1% of possible time in 1916. There were treated 514,000 tons of ore, as against 601,854 tons milled in 1916. Working costs per ton milled were $4.439 in 1917, as compared with $4.033 in 1916, and $3.98 in 1915.

The Mining News

ALABAMA

GREISEMER GRAPHITE CO. (Ashland)—Plant destroyed by fire; loss, $200,000. The plant had been in operation only a few months. It is not known whether it will be rebuilt.

ARIZONA

Mohave County

UNITED OATMAN (Oatman)—The juncture of the branches of the Ophir vein has been reached at the 850-ft. point in the tunnel.

GOLD RANGE (Oatman)—The shaft is to be sunk an additional 200 ft. and the property is to be developed in conjunction with the Gold Road Bonanza.

GREY EAGLE (Oatman)—A raise is being driven from the 400 level to the surface. A winze will be sunk to connect with the crosscut now being driven from the Aztec. This work will not only improve the ventilation but will greatly facilitate development of the Grey Eagle.

Pinal County

ARIZONA HERCULES (Kelvin)—Switchboard is being installed at the central power plant, which will be started in March. Grading for the railroad spur to connect with the main line of the R. & G. V. R.R. nearly completed.

Yavapai County

WALNUT SPRINGS (Jerome)—Tom Smart, owning claims about three miles west of Jerome, is developing a potassium deposit of some merit.

WEST UNITED VERDE (Jerome)—Formerly known as the Jerome Victor Extension. Shaft is being unwatered and sinking is to be resumed. Lateral development is planned for the 2000-ft. level.

VERDE COMBINATION (Jerome)—The porphyry contact has been cut on the 600 level at a point 580 ft. from the shaft. Between the schist and porphyry there is a 2-ft. streak of quartz carrying some chalcopyrite.

YEAGER CANYON (Prescott)—N. L. Amster, of Boston, and J. W. Bennie, manager of the Shannon Copper Co., have taken over the Yeager Canyon property, which is to be equipped with electrical machinery. Electric hoists and pumps are on the way and development work has already been started. It is expected that shipments will be made by June of this year.

AMERICAN-ARIZONA (Phoenix)—A syndicate of Waterloo, Iowa, business men has purchased the Vincent Fortune property, in the New River district, 35 miles north of Phoenix. The property is about three and one-half miles south of the Kay property, recently acquired by George W. Long and associates, and adjoins on the north property owned by E. H. Yawkey, of New York. The newly formed syndicate will operate under the name of American-Arizona Copper Mining Co.

ARKANSAS

Independence County

INDEPENDENCE MINING CO. (Batesville)—Has purchased another steam shovel which will be put in operation immediately at Polk-Southard mine.

Marion County

GROUNDHOG (Buffalo)—Mill under construction will be completed by Apr. 1. Will mine and treat zinc-carbonate ore.

MARY AGNES (Buffalo)—William A. Barr, operating under lease, has struck body of high-grade carbonate in first prospect tunnel.

J. C. SHEPHERD (Rush)—Has taken leases in the Batesville manganese field on Polk Bayou, near Batesville, and will start active mining operations this month.

NORTH STAR (Yellville)—F. C. Heywood announces a drilling campaign for this spring. Will prospect in the valleys for deep bodies of sphalerite. Operations now being conducted on upper carbonate run. Property equipped with 50-ton concentrating plant.

CALIFORNIA

Amador County

CENTRAL EUREKA (Sutter Creek)—Preparations for deepening shaft completed. Indications on 3450 level encourage belief of persistence of the orebody to 500 ft. further depth. Thirty stamps of the 40-stamp mill dropping on good ore, chiefly from the 2600 level.

Placer County

PIONEER (Forest Hill)—High-grade ore reported, attracting attention of prospectors and miners to this section of Forest Hill divide.

Shasta County

AFTERTHOUGHT (Ingot)—Immediate construction of 20 cottages for miners and families ordered by the company. Improvements in flotation plant reported progressing satisfactorily.

Siskiyou County

SPRINGFIELD TUNNEL (Columbia)—Work has started to tap the ancient channel, which has been explored by prospecting shafts. Expected to complete the tunnel in six months. Machinery used at the old tunnel in Stanislaus Canyon has been moved to the new site, to be installed after the necessary surface buildings are completed. Joseph Cadamartori is superintendent.

Tuolumne County

GAGE (Shawmut)—Reported high-grade ore disclosed at bottom of 72-ft. shaft. Drifting is in progress. Property was op-

tioned by Henry T. Gage, of Los Angeles, about a year ago. Option continued by his son, Francis Gage, after the elder had determined to terminate it.

SIERRA DEVELOPMENT CO. (Jamestown)—Gold-bearing gravel reported in bottom of prospect shaft on this property, situated on north side of Knight's Ferry road, two miles from Jamestown. Successful operation will attract other investment in Table Mountain district.

COLORADO

Boulder County

UNITED STATES GOLD CORPORATION (Sugar Loaf)—For present work will be confined to development.

Clear Creek County

ARGENTINE & CREOLE (Georgetown)—Will be worked by pool of local men. Properties on Leavenworth mountain.

ALAMOSA MINING & LEASING CO. (Idaho Springs)—Recently organized to develop mine near Idaho Springs.

IDAHO (Idaho Springs)—Recently reopened, and good-grade ore exposed in development work.

BIRMINGHAM MINING CO. (Idaho Springs)—Has recently taken over mine of Big Forty Co. and will begin development work.

Gilpin County

STAR OF THE WEST (Central City)—Regular shipments of high-grade lead-silver ore made.

Lake County

MT. CHAMPION (Leadville)—Winze being sunk to develop at depth oreshoots mined on levels above.

Ouray County

YELLOW JACKET (Ouray)—Development work being done on this Bear Creek property. Mill may be completed in spring. C. Wilfley, manager.

CAMP BIRD (Ouray)—Tunnel heading was advanced 460 ft. in December. Another vein giving good assay value has been cut. Breast now under portal of old boarding house adit, through which mine was formerly worked.

RED MOUNTAIN MINES (Ironton)—Operating Genesee-Vanderbilt, Robinson, Yankee Girl and Joker tunnel properties under lease and option. Winter snows have blocked railroad, so work is confined to development until spring. Joker tunnel cuts Yankee Girl shaft below 600 level, and shaft will be unwatered from that point. Development work in Genesee tunnel progressing steadily.

San Juan County

ST. PAUL (Red Mountain)—Has been leased to Louis Schafer and associates, of Silverton. The property has been reopened and will be actively developed. An electric hoist has been installed.

San Miguel County

JANUARY CONCENTRATE SHIPMENTS from Telluride district were: Tomboy, 50 cars; Smuggler-Union and Black Bear, 60 cars; Liberty Bell, 12 cars; total, 122 cars.

CARRUTHERS (Ophir)—Mill shut down for winter on account of water shortage.

NEW DOMINION (Ophir)—Car of crude ore shipped recently returned $300.

LIBERTY BELL (Telluride)—Stated company has lease on block of ground on Humboldt claim, recently purchased by Smuggler-Union. Ground lies on Ouray County side, but ore is trammed through workings to San Miguel County and treated near Telluride.

Summit County

ELLA (Breckenridge)—Shipping high-grade lead-silver ore to local sampling plant.

BLACK METAL (Kokomo)—Lessees have shipped molybdenum ore to Leadville for treatment in Pingree mill.

RED CHIEF MOUNTAIN (Montezuma) Company of Denver men organized to work old Square Deal property.

WELLINGTON (Breckenridge)—Making regular shipments of lead and zinc concentrates and of crude lead-silver ore.

MOLYBDENUM PRODUCTS CO. (Buffer)—Milling plant nearing completion. Capacity to be 250 to 300 tons per day. Company has large acreage in Fremont Pass section.

Teller County

MARY McKINNEY (Cripple Creek)—Stated main workings will be leased. Ground being divided into blocks.

BIG TOAD (Cripple Creek)—Reid mill remodeled, and milling operations will be started in spring. Operating Dante mine.

EXCELSIOR (Cripple Creek)—Operating Longfellow mine of Stratton Estate. Building new ore house. Production to begin about February.

GRANITE (Cripple Creek)—Regular production made by lessees on Granite, Gold Coin, Monument and Dead Pine mines, and by company on Dillon. Company owns 40 acres patented on Battle Mountain.

VINDICATOR (Cripple Creek)—Deep level development work will be done in both Vindicator and Golden Cycle mines. Some levels of Vindicator No. 2 shaft will be blocked out and leased. Many applications made.

GEORGIA

Hall County

CHESTATEE PYRITES AND CHEMICAL CO. (Chestatee)—Excavation started for experimental mill. Site selected for final mill and 500- or 1000-ton units will be constructed upon completion of tests. Mine has one of the largest deposits of workable pyrite known in this country, lying in a vein two miles long and from four to 35 ft. wide. The ore will be hoisted in 2-ton skips, hand picked from belts after a preliminary coarse screening and crushing, reduced to 2 mm. and concentrated on Hancock jigs and Butchart tables. Fine-grinding and flotation are contemplated. The sorted ore will be shipped direct and the milling grade will have a ratio of concentration of from 1½ to 2 into 1. The company is enlarging its 1000-hp. hydro-electric power plant to 1500 hp. and controls other power sites within a short distance, and is completing a broad-gage railroad to Clermont, a distance of 10 miles, on the lines of the Gainesville Northwestern R.R. The Government has recognized the merits of this enterprise and will assist production in every manner possible. N. P. Pratt is president and manager.

IDAHO

Bonner County

ARMSTEAD MINES, INC. (Talache)—Adit No. 3 has reached footwall after passing through a vein of concentrating ore 10 ft. wide, which it has cut at a depth of 1600 ft. on the dip. The length of the tunnel is 3092 ft. The vein will be developed by a long raise and drifts. Experimentation on the ore will begin at once to establish the proper flow sheet, and mill construction will be started at the earliest opportunity. H. H. Armstead is president.

Shoshone County

CARBONATE HILL GIANT (Mullan)—A hoist and other machinery have been delivered at the property preparatory to sinking a shaft 1000 ft. if necessary to prospect the ground. This enterprise is being directed by W. D. Greenough, who has consolidated the Carbonate Hill and Giant groups of claims. Considerable lead and zinc ore has been developed on Carbonate Hill. The operations as planned are regarded of great importance.

FEDERAL (Wallace)—The Mace mines (Standard-Mammoth) of the Federal Mining and Smelting Co., which were closed down about the first of the year on account of the exhaustion of the known ore deposits, are not to be abandoned without further exploratory work. The company owns 1700 ft. of ground north of the Standard-Mammoth vein and extending to the Tamarack and Custer. It is known that several veins cross this ground and it is in the heart of one of the richest sections in the district. General Manager Frederick Burbidge has announced that a crosscut will be run from No. 6 tunnel level north to prospect this virgin ground.

MICHIGAN

Copper

FRANKLIN (Demmon)—In January, average daily tonnage of ore of 1100.

CENTENNIAL (Houghton)—Two lower levels are today in better ground than at any time previous.

SOUTH LAKE (Lake Mine)—Yield for January, 16 lb. copper per ton. Previous monthly record, 14½ lb. per ton; ore tonnage, 2300; working only one shift.

MOHAWK (Houghton)—Mohawk is continuing to make an excellent record. Production for January was 1,338,000 lb. of copper.

KEWEENAW COPPER (Calumet)—Shares of stockholders who have not paid $1 assessment, due July 2, 1917, will be sold at Calumet, Mar. 6

VICTORIA (Victoria Mine)—Record yield of 15 lb. of copper per ton made three last months; average, 11 lb. per ton. Copper for January, 128 tons; for December, 138 tons, and for November, 135 tons. Miners are scarce.

WINONA (Winona)—Copper yield for January, about 15 lb. per ton; for December, the same as for November, 17 lb., and October, 16 lb. per ton. Best grade is coming from No. 3 shaft. Unless there is a decided change in the metal market, the tributers reasonably can be expected to operate the Winona for at least another five months.

SENECA (Houghton)—Actual shaft sinking now is under way at the Seneca property. Everything on the surface is adequate, equipment is complete in every detail, a good crew has been gathered and the Lake Superior record for speedy shaft sinking probably will be broken at the Seneca.

COPPER RANGE (Houghton)—The Champion mine continues to utilize the tailings from the mill for mine filling. The Baltic is a wide lode. The selection of ore, underground, the rock filling and stone replacement work have been reduced to a practical basis, so that timber costs are practically nothing. In addition to the use of ordinary sands, the reground sands are all used in the mine filling.

WOLVERINE (Houghton)—The January output for Wolverine was such a decided falling off from normal as to cause considerable apprehension. The production of copper was 350,957 lb., as compared with 426,256 for December. There was no appreciable decrease in the percentage of copper in the ore, but simply a falling off in output. At the present time the indications are that the February showing will be better than January, notwithstanding the fact that February is a short month.

Iron

AMASA PORTER (Amasa)—Eleven men caught in a cave-in. Rescue crew succeeded in releasing three, but little hope is held out for the others.

MINNESOTA

Mesabi Range

JONES AND LAUGHLIN CO. (Hibbing)—Main shaft of the new South Agnew mine has been sunk 100 ft. below the collar and as yet has had no trouble with water or quicksand.

OLIVER IRON MINING CO. (Chisholm)—Fire destroyed shaft house at Clark mine. Origin is supposed to have been from sparks from blacksmith shop. Mine is an active shipper to the Minnesota Steel Co. at Duluth. A new wooden headframe is being rushed to completion.

ALBANY MINE (Hibbing)—The Pickands-Mather Co. is installing three electrically driven pumps, the last of the equipment for the property's complete electrification. Work is being concentrated on the new 260-ft. tramming level, where ore will be brought to the shaft from the newly opened-up area east of the pit.

JOHNSON MINE (Virginia)—Controlled by the Minnesota Coöperative Mining Co., of which James Cardle, of St. Paul, is president. Sinking a shaft near the Prindle mine on Section 6. The orebody contains 350,000 tons of high-grade bessemer ore and it is expected that 50,000 tons will be shipped the coming season.

ROBERTS MINE (McKinley)—Reopened by the Bowe-Burke interests and will be renamed the Emmit mine. These people also operate the Morrow and Burns mines at Eveleth. The Roberts mine, which is owned in fee by Mr. Roberts, of Minneapolis, was opened in 1906 by the New York State Steel Co. and operated by that company till 1912, when the company went into bankruptcy.

WISTAR MINING CO. (McKinley)—Clement K. Quinn and associates will begin at once to develop by shaft the Wistar mine, a 40-acre tract on Section 17-58-16, just south of the McKinley mine of the Oliver Iron Mining Co. This property is owned in fee by Henry Stevens' estate, of Detroit, Mich., and was explored in 1917. The Wistar company has delivered some equipment and the Duluth & Iron Range R.R. will build a spur to the property.

MISSOURI

Joplin County

COMMONWEALTH (Picher, Okla.)—Sinking shaft on lease near Treece, Kan. Will build new mill, or move No. 1 plant from location east of Picher.

VELVET (Miami, Okla.)—Starting active development on tract on Four Mile Creek in new field south of Miami. M. Dawedoff, Miami, secretary-treasurer.

CONSTITUTIONAL L. & Z. (Miami, Okla.)—Has bought Midas mine and 20-acre lease at Picher. Walter Eberlien, Joplin, superintendent.

AKSARBEN (Baxter, Kan.)—Planning mill for developed tract on Cooper land, just south of Baxter. John Voorhees, Anita, Ia., is president.

BILLIKEN (St. Louis, Okla.)—Has purchased U. S. Paymaster mill, at Joplin, which will move to lease near St. Louis. Plant erected in 1917. John Aycocks, president and manager, El Reno, Okla.

SPELTER (Quapaw, Okla.)—Will build mill on lease of Abrams land, northeast of Quapaw, Okla. John J. Gurlach, Woodward, Okla., is president. Company capitalized for $150,000.

BUFFALO (Miami, Okla.)—Mine north of Quapaw disappointment until new manager drilled hole 16 ft. in floor of drift, and blew it out with 57 sticks of dynamite. Cavern created revealed 12-ft. face of ore.

ACME (Picher, Okla.)—Has started in operation second mill on lease southeast of Picher. Big tonnage of ore on dump, as mill has been delayed in completion. J. W. Wingfield, Webb City, general manager.

JOPLIN-SAPULPA (Joplin)—Has bought Lucky Shot lease near Waco. Will add sludge plant and remodel mill. Now reopening ground. H. G. Beard, Sapulpa, Okla., head of company. L. W. Vidler, Joplin, consulting engineer.

DE ARMOND (Treece, Kan.)—Have new 300-ton mill ready for operation. Two shafts down into orebody at depth 160 ft. Air drifts have been driven. Dr. M. M. DeArmond, secretary and general manager, Mangum, Okla.

GEORGETTE (Wentworth)—Making extra good production at two mills near Wentworth. Last week averaged 50 tons daily with 10-hr. shift. Half of this output made by No. 2 mill, with only four shovelers in mine. Ore averaged about 15% sulphide recovery. O. B. Henry, Wentworth, manager.

BENEDENE (Oklahoma City)—Will build mill on lease near state line, south of Baxter. Eastern drill holes on 20-acre lease show ore. Water flow not heavy. Assays show trace of gold and high zinc. Office, 516 State National Bank Bldg., Oklahoma City. J. R. Green, superintendent.

MONTANA

Granite County

WHITE HORSE (Philipsburg)—Face of 180-ft. tunnel broke into high-grade manganese vein and preparations being made for regular shipments. Robert McDonee, lessee.

Silver Bow County

NORTH BUTTE (Butte)—During quarter ended Dec. 31, 1917, there was mined and shipped 31,829 wet tons of ore and three wet tons of precipitate. There was treated 30,105 dry tons of ore and 2¼ dry tons of precipitate, resulting in 1,752,024 lb. of copper, 56,485 oz. of silver and 90 oz. of gold. Financial statement shows surplus of $4,860,784. Completion of concreting of Granite Mountain shaft, destroyed by fire last June, is announced at cost of $214,292. Mine is expected to be in full operation soon. Sarsfield shaft on company's east side properties is now 459 ft. below surface. New 200-hp. compressor will be installed there to take care of water in sinking.

NEVADA

Nye County

RED TOP (Manhattan)—South drift has reached point 300 ft. from shaft. The formation remains unchanged, the drift running along west side of fault plane, 184 ft. east of shaft.

WHITE CAPS EX. (Manhattan)—Drift southeast on the 400-ft. level now measures 188 ft. from station. The fault between two limestone blocks has just been crossed. Drift now changed to crosscut northeast, paralleling fault plane, and main limestone belt will now be the objective.

MANHATTAN CON. (Manhattan)—The shaft is now 82 ft. below the 4th level and ground extremely hard, with timber sets in place for a distance of 66 ft. Fifteen feet of quartzite was passed, and since then the formation is a black lime shale with streaks of quartzite intermixed.

UNION AMALGAMATED (Manhattan) Enlarging of Earl shaft has reached 600-ft. level of Bath workings. The shaft has now two full compartments. Will take a week to cut and timber the station. The Ingersoll-Rand compressor is installed and air ready to turn on as soon as the air line is completed down the shaft.

WHITE CAPS (Manhattan)—A raise started on the fifth level on east orebody has been extended 30 ft. from level, being all in high-grade mill ore and will be carried through to 4th level. West drift from 5th level has reached a distance of 270 ft. from station. Will require 110 ft. more before passing out of shale and reaching limestone. The extraction is proving up to expectations. Mill treated about 100 tons per day since starting up. The first clean-up of precipitates was made Feb. 16.

Storey County

MEXICAN (Virginia)—Development in 2300 level in quartz sampling $6.63 to $7.85 per ton.

SIERRA NEVADA (Virginia)—Development in 2500 level disclosed 12 in. on the footwall assaying $30 per ton.

JACKET (Gold Hill)—Saved 10 cars of ore from surface tunnel and 13 cars from Jacket shaft. Sent 220 tons to mill glory-hole; 316 tons to mill bins. Mill tables and old cyanide plant working.

UNION CON. (Virginia)—Ore mined in the 2300, 2400, 2500 levels assayed from $9.38 to $70.84 per ton. The high-grade came from the 2300; ore on the 2400 level assays as high as $37.26 per ton; on the 2500 level, $37.38 per ton. Besides sending to the Mexican mill ore which produced a total of $10,000, the Union shipped five bars of bullion to Selby. Development on 2600 level is in low-grade quartz.

UTAH

Beaver County

MAJESTIC (Milford)—From Old Hickory mine during three months ended Jan. 31, 3150 tons of ore shipped. In January, 1250 tons. Ore averages 2 to 3% copper.

Juab County

CHIEF CONSOLIDATED (Eureka)—Shipments during 1917 amounted to 59,950 dry tons, which brought $1,554,714, after payment of smelting, sampling, and transportation charges. Metal content of ore: 9175 oz. gold, 1,534,907 oz. silver, 10,780,540 lb. lead, and 600,236 lb. zinc. Net profit, after payment of all charges $427,637. Average net value of ore after payment of smelting, freight and sampling, $25.93, and gross value $40.12 per ton.

Salt Lake County

COLUMBUS-REXALL (Alta)—Shipped 744 tons since Jan. 26, of an estimated gross value of $30,000. Orebody being further developed.

ALTA CON. (Alta)—Car of ore shipped recently and another nearly loaded. Several faces being worked, as new lower workings from Copper Prince tunnel, Brooklyn workings, and new ground to east of latter.

CARDIFF (Salt Lake)—Drifting being done on 800 level to prospect at greater depth limestone-quartzite contact along which main orebody was found. South Fork 600-ton bins being filled and surplus ore to be stockpiled alongside preparatory for spring hauling and shipping season.

UTAH COPPER (Bingham)—Estimated Federal taxes will increase costs of copper production by 3c. per lb., rising wages and costs of materials adding 50% over 1916. Normally about 105 days required from mine output to refinery output, and this increased 50% or more, owing to railroad congestion.

WASATCH MINES (Alta)—Tunnel 1600 to 1700 ft. and expected to cut some fissures soon. Main objective point is under old Columbus stope, 3000 ft. further on. Power plant supplying number of Alta mines in good shape. Arrangements with Utah Power and Light Co. whereby power can be switched on when Wasatch plant meets with breakdown.

OHIO COPPER (Bingham)—Report for six months ended June 30, 1917, shows net profits of $256,257, production having amounted to 2,769,677 lb. copper, selling for 27.125c. per lb. Cost of flotation plant given as $400,000 and estimation of tailings dump at 4,000,000 tons. Flotation expected to increase extraction from 45 and 50% to 80%. At present old mill treating over 2000 tons daily. Installation of first unit of flotation plant about ready. Old directorate reëlected at recent meeting. N. E. Rogers, president.

Summit County

ONTARIO (Park City)—Lessees shipping from upper levels, and company from lower. Much ore in sight.

JUDGE MINING AND SMELTING (Park City)—Roaster repaired after fire of few days ago and operating smoothly. Damage estimated at about $15,000.

Tooele County

LUCKY STAR COPPER (Salt Lake)—Property in Dugway district making up car of copper-silver ore, with view to shipping via Faust Station.

COPPEROPOLIS (Gold Hill)—Car of copper-gold-silver ore on way to market. Property controlled by Bamberger-Dunyon interests.

WOODMAN MINING (Gold Hill)—In Frankie mine crosscut from winze 150 ft. below surface, lowest workings, has opened several feet of ore. Mining being done in several places.

WESTERN UTAH EX. (Gold Hill)—Development being done in several places with encouraging results. No. 1 tunnel and crosscut in 500 ft. and winze from tunnel on Helmet vein down 30 ft. Mogul shaft down 150 ft. and inclined shaft about 130 ft.

GARRISON MONSTER (Gold Hill)—Bismuth ore of good grade reported in Turner-Chase lease. Lessees also mining lead-silver ore. Company developing ore in porphyry incline and in Uncle Sam vein. Car shipped recently from former and car from latter being prepared for market. Stated to have large deposit of iron ore carrying some lead and silver. Ore being taken out from higher grade streaks in this body.

Utah County

PACIFIC GOLD (American Fork)—Report covering 11 months ended Jan. 1 shows $3362 received in royalties and $2306 on hand at end of period. Name of leasing company changed from Fissures Exploration to American Exploration, when in March, 1917, control passed to W. E. Dilloway. Lease to American Exploration Co. expires June 7, 1919, unless $50,000 payment is made, in which case lease would automatically continue five years longer. So far, $12,299 received from royalties. Fifty-ton mill built at Dutchman mine by Fissures Exploration dismantled, and new 150-ton mill constructed at Pacific by Dilloway interests. First car of concentrates shipped Oct. 22.

WASHINGTON

Stevens County

DIAMOND R MINING CO. (Metaline)—Three years' option by this new company taken on the Diamond R and Bella May properties of the Spokane Lead Co. in the Metaline district. Officers of the company are R. H. Hutchinson and W. H. Crawford.

CANADA

Ontario

KERR LAKE (Cobalt)—Production for January was 204,641 oz. of silver.

BEAVER (Cobalt)—An important body of high-grade ore being opened up on the 700 and 800 levels.

MURRAY-MOGRIDGE (Wolf Lake)—Drifting on the 200 level shows that the vein maintains consistency in gold content.

DOME EXTENSION (Porcupine)—This company is arranging for an extension of the drilling carried on by the Dome Mines.

TEMISKAMING (Cobalt)—President J. P. Bickell and several of the directors paid a three-day visit of inspection to the mine, returning to Toronto on the 13th.

KIRKLAND LAKE (Kirkland Lake)—The T. & N. O. Ry. has decided not to build the spur into this camp until conditions for construction become more favorable.

NIPISSING (Cobalt)—During January the company mined ore of an estimated value of $307,019, and shipped bullion and customs ore of an estimated net value of $310,881. Explorations in new areas will be started from shaft No. 63, which has been dewatered.

BURNSIDE (Kirkland Lake)—Development work has begun, power being conveyed to the property by a pipe line from the Sylvanite plant. No. 2 shaft is being put down to a depth of 155 ft., from which point a crosscut will be run to pick up one of the Tough Oakes veins. No. 1 shaft will be pumped out and deepened.

ADANAC (Cobalt)—The shareholders on Feb. 14 voted to increase the capital from $2,500,000 to $3,000,000. At present only one-half of the additional stock will be issued, which will be offered to the shareholders on a pro rata basis at 10c. per share. Those taking up the stock will be entitled to subscribe after Sept. 1 to the issue of the remaining shares on the same basis.

DAVIDSON (Porcupine)—At the annual meeting, Feb. 13, the president reported that total amount of ore blocked out and in sight down to 200 ft. level was 100,000 tons, probably averaging $10 per ton. Additional large bodies of low-grade ore were indicated by lateral work between 200 and 300 levels. Diamond drilling close to 500 level disclosed a vein 35 ft. wide, five feet of which carried high-grade ore.

The Market Report

SILVER AND STERLING EXCHANGE

Feb.	Sterling Exchange	Silver New York, Cents	Silver London, Pence	Feb.	Sterling Exchange	Silver New York, Cents	Silver London, Pence
21	4.7530	85⅛	42⅛	25	4.7530	85⅛	42⅛
22	4.7530	....	42⅛	26	4 7530	85⅛	42⅛
23	4.7530	85⅛	42⅛	27	4.7530	85⅛	42⅛

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London quotations are in pence per troy ounce of sterling silver, 925 fine.

DAILY PRICES OF METALS IN NEW YORK

Feb.	Copper Electrolytic	Tin Spot.	Lead N. Y.	Lead St. L.	Zinc St. L.
21	*23½	†	7	6 95 @7.00	7.55 @7.60
22	....	..	..	.....	.....
23	*23½	†	7	6 95 @7.00	7.55 @7.60
25	*23½	†	7	6.95 @7 00	7.55 @7.60
26	*23½	†	7 @7¼	6.95 @7.20	7.50 @7.55
27	*23½	†	7¼	7 20 @7.25	7.50 @7.55

* Price fixed by agreement between American copper producers and the U. S. Government, according to official statement for publication on Friday, September 21, 1917.

† No market.

The above quotations (except as to copper, the price for which has been fixed by agreement between American copper producers and the U. S. Government, wherein there is no free market) are our appraisal of the average of the major markets based generally on sales as made and reported by producers and agencies, and represent to the best of our judgment the prevailing values of the metals for the deliveries constituting the major markets, reduced to basis of New York, cash, except where St. Louis is the normal basing point.

The quotations for electrolytic copper are for cakes, ingots and wirebars.

We quote electrolytic cathodes at 0.05 to 0.10c. below the price of wirebars, cakes and ingots.

Quotations for spelter are for ordinary Prime Western brands. We quote New York price at 17.5c. per 100 lb. above St. Louis.

Some current freight rates on metals per 100 lb. are: St. Louis-New York 17c.; St. Louis-Chicago, .3c.; St. Louis-Pittsburgh, 13.1 cents.

LONDON

Feb.	Copper Standard Spot	Copper Standard 3 Mos.	Copper Electrolytic	Tin Spot	Tin 3 Mos.	Lead Spot	Zinc Spot
21	110	110	125	315½	312	29½	54
22	110	110	125	314	311	29½	54
23	....	....	....	....	....	....	....
25	110	110	125	314	311	29½	54
26	110	110	125	318	314	29½	54
27	110	110	125	318	314	29½	54

The above table gives the closing quotations on London Metal Exchange. All prices are in pounds sterling per ton of 2,240 lb. For convenience in comparison of London prices, in pounds sterling per 2,240 lb., with American prices in cents per pound the following approximate ratios are given, reckoning exchange at $4.7515. £29½ = 6.2576c.; £54 = 11.4545c.; £110 = 23.3333c.; £125 = 26.5151c.; £260 = 55.1513c.; £280 = 59.3937c.; £300 = 63.6362c. Variations, £1 = 0.2121205c.

Metal Markets

NEW YORK—Feb. 27, 1918

Lead is now the only metal that exhibits any market interest. It was stronger again this week. Respecting copper, zinc and tin, there is nothing new to be said.

Copper—The U. S. Government is taking a good deal. Our allies have lately reduced their purchases, owing to the shipping deficiency, and have directed their attention to cleaning up their accumulations here. However, some large new orders have been placed.

Talk in the newspapers about the refiners compelling the mining companies to consent to a revision of refining contracts, owing to increased costs, caused some gossip in the offices of the refiners. That refining costs have largely increased is no illusion, but a contract is a contract, which is appreciated by none better than the copper refiners.

Copper Sheets are quoted at 31½c. per lb., f.o.b. mill, for hot rolled, and 1c. higher for cold rolled. Copper wire is quoted at 26 to 26½c. f.o.b. mill, carload lots.

Tin—In spot Straits there is still no market. A 5-ton lot of prompt Banka was sold at 86c. on Feb. 25.

Lead—There were transactions in round lots—100@300-ton lots—every day in the week, and there was a fairly widespread inquiry from consumers. Some producers did not book all the orders they might have done. The A. S. & R. Co. advanced its price to 7¼c. on Feb. 26.

Zinc—Small business done from day to day was mostly at prices of from 7.55 to 7.60c. An ordnance order for 250 tons of Grade C or "select" spelter on Feb. 26 was awarded to a bidder at 7.90c., New York. This is figured equivalent to 7.50c. for Prime Western spelter at St. Louis, possibly a shade lower.

Zinc Sheets—$15 per 100 lb., unchanged.

Other Metals

Aluminum—The market is firmer; prices 37@39c. per lb. for No. 1 ingots at New York.

Antimony—A moderate volume of business, perhaps 100 tons, was done at 13¾c. for spot, which we quote. Futures are quoted at 12½@12¾c. c.i.f. in bond, and not very freely offered.

Bismuth—Metal of the highest purity for pharmaceutical use is quoted at $3.35 per lb. for wholesale lots—500 lb. and over. The market is quiet.

Cadmium—This metal is quoted at $1.50 @1.75 per lb., depending on the quantity.

Nickel—Steady at 50c. per lb., premium of 5c. per lb. for electrolytic.

Quicksilver—Unchanged at $115. San Francisco reports, by telegraph, $115, barely steady.

Gold, Silver and Platinum

Gold—An additional export of $150,000 in gold coin by the National City Bank to Mexico was authorized on Feb. 26 by the Federal Reserve Board, pursuant to agreement entered into between the State Department and Mexican officials. It is understood that this export was on account of sisal shipments.

Great increases in silver exports to the East were a feature of the 1917 movement of the precious metals. A Washington dispatch states that China took $12,106,600, about twice as much as in the previous year. Purchases for British India jumped from $2,384,467 to $24,392,402. Imports into the United States from Mexico were $32,000,000, an increase. Gold exports to Mexico amounted to about $13,000,000, or 12 times as much as in the previous year. The only countries to which we exported over $100,000,000 in gold last year were Japan and Spain. Exports to Latin America, however, showed substantial increases, owing to growing trade.

Silver—Continues steady at 42⅛d. in London. The demand for silver is continuous. It is only a question of what will be the price—higher or lower. Advices from India are to the effect that the issue of one-rupee notes appears to have met with immediate response on the part of the public. It is to be noted that the shrinkage of the metallic reserve in the India Treasury continues. This means that buying of silver for mintage must continue.

Mexican dollars at New York: Feb. 21, 68; Feb. 23, 68; Feb. 25, 68; Feb. 26, 68; Feb. 27, 68.

Platinum — In good demand at $108, which we quote.

Palladium—Demand good, supplies small. Some transactions were booked as high as $140. We quote $138@140.

Zinc and Lead Ore Markets

Joplin, Mo., Feb. 23—(By telegraph)—Blende, per ton, high, $67.75; basis 60% Zn, premium, $65; medium to low, $60@50; average base, $57.50; calamine, per ton, 40% Zn, $38@35; average selling price: blende, $57.03; calamine, $40.68; all ores of zinc, $55.85 per ton.

Lead; high, $86.90; basis 80% Pb, $86@85; average selling prices, all grades of lead, $80 per ton.

Shipments the week: Blende, 5625; calamine, 438; lead, 1067 tons. Value all ores the week, $424,030.

As is frequently the rule when prices are lowered, a preponderance of high-grade ores are shipped. Prices were generally lowered on best and all intermediate grades from $2 to $2.50 per ton, with an average price of shipments higher than last week.

Platteville, Wis., Feb. 23—(By telegraph)—Blende, per ton, basis 60% zinc, $61 base for premium grade down to $57 base for second grade. Lead ore, basis 80% lead, $83 per ton. Shipments reported for the week are: 1928 tons of blende, 190 tons galena and 513 tons of sulphur ore. For the year to date the figures are 16,547 tons of blende, 531 tons of galena and 3996 tons of sulphur ore. Shipped during the week to separating plants, 2887 tons of blende.

Other Ores

Manganese Ore—Sales as high as $1.30 per unit for metallurgical ore of 48% grade and upward were reported, but these were exceptional cases and the major market is still quoted at $1.20.

Molybdenum Ore—Quoted at $2.10@2.20 for 85% grade. Sales small.

Pyrites—Spanish lump is quoted at 15½c. per unit, on basis of 10s. ocean freight, buyer to pay excess freight and war risk, except that, depending on conditions, concession of 2% of war risk may be allowed. Ocean rates remain at 35s. for Northern and 42s. 6d. for Southern ports. Cargo tonnage is scarce; only half the tonnage required in January was secured.

Tungsten Ore—Sheelite, $26, nominal. No transactions reported. Wolframite $20@24, according to grade. Sales moderate. Considerable business for future delivery was done, the British Government having given permission for shipments from Hong Kong to the United States after the ore has first been offered to the British Munitions Ministry.

Iron Trade Review

PITTSBURGH—Feb. 26

Very confusing statements are being made with respect to the iron and steel production. The divergencies arise chiefly from the loose use of terms, but partly from an optimism that fails to distinguish prospects from realization. As to misuse of terms, the railroad clean-up during the last three weeks of favorable weather resulted, as already noted in these reports, in the movement to blast furnaces of a great deal of coke that was blocked en route, whereby the production of pig iron has greatly increased, being now at a rate of 75% or more of capacity, against about 55% in the worst period, but this increased rate cannot possibly be maintained unless coke shipments are better. For three weeks past the Connellsville shipments have averaged about 100,000 tons a week under requirements. At many steel works it is preferable, rather than carry pig iron, to convert it into ingots even if the ingots cannot be finished. Car supplies at the steel works have on the whole increased

only slightly and in some instances have decreased. Mill warehouses and yards are so well filled that more steel cannot be finished than can be shipped. The result is that steel shipments are only slightly increased, and are averaging not much over 60% of capacity.

When "production" is stated in terms of pig iron or ingots it appears much larger than when stated in terms of finished rolled products, the production and shipment of which, as indicated, are barely more than 60% of capacity. It is merely an incident that the rate of ingot or of pig iron production is at a higher percentage, for the practical measure of results is the steel finished and shipped.

Optimism that presages better shipments of steel as a result of the railroads clearing up their congestion is entirely justified, but when it leads to statements that the increased shipments expected are already occurring it is misleading. It is clear now that the railroads in this clean-up have carefully pursued the policy of directing all their energy to moving loaded cars to destination, to clear congestion, leaving for a later time the furnishing of more empty cars for additional loading. The result is that car supplies in the Connellsville coke region and at the steel mills have increased only slightly.

Demand in the open market continues extremely light. It is quite uncertain whether ordinary commercial consumers of steel would accept much heavier deliveries if they could be offered. As to the war program, there is no evidence that it is being retarded to any material extent by insufficient deliveries of steel. Delays, if any, are, as a rule, in the fabrication or working up of the steel into the final implements, goods, or structures for war purposes. The most impressive illustration is that of plates. A year ago a wooden-ship program was being considered because it was thought plates were unobtainable. The wooden-ship program was replaced by a very ambitious steel-ship program, yet there is today no delay in steel shipbuilding by reason of plates not being furnished. When such conditions obtain, both as to war steel and as to commercial steel, with shipments of steel at less than two-thirds capacity, discussion of eliminating unessential consumption of steel is misdirected. Transportation is the vital issue. The additional amount of transportation required for full operation of the iron and steel industry is only between 1% and 2% of the total ton-mileage service that was being rendered by the railroads.

Pig Iron — Furnaces are making occasional small sales of prompt iron to customers really in need of better deliveries, although on the whole they are far behind in deliveries. Occasional transactions occur in foundry iron for second half, subject to price revision. The widespread inquiry for foundry coke suggests that foundries would require much more foundry iron than is now being supplied if they had the necessary coke. The market is strictly aligned to the set prices: Bessemer, $36.30; basic and foundry, $33; malleable, $33.50; forge, $32, f.o.b. furnace, freight from the Valleys to Pittsburgh being 95c.

Steel—There is considerable demand for soft steel billets and sheet bars in small prompt lots, but there are practically no offerings. Sheet discard steel is offered rather freely, at slight concessions from the set prices for soft steel, but transactions are light because shipping permits are difficult to secure. Regular prices remain: Billets, $47.50; sheet bars $51; slabs, $50; small billets. $51; rods, $57.

Ferroalloys

Ferromanganese—The market is rather narrow. The regular quotation for spot or forward remains $250, delivered, but, as formerly, sellers usually cut the price when any tonnage is involved, generally by from $1 to $3 a ton.

Coke

Connellsville—Last week's car supplies were disappointing, as they showed practically no improvement. This means that for three weeks past shipments have been 275,000 to 280,000 tons per week, against an average of 421,000 tons in 1916, and present requirements of fully 375,000 tons. Car supplies this week have shown no improvement. Spot coke is rarely offered loaded in Pennsylvania or B. & O. cars, but loaded in P. & L. E. cars is frequently offered, there being few consumers on that line not already well supplied. The market remains as the set prices: Furnace, $6; foundry, 72-hour selected, $7; crushed, over 1 in., $7.30, per net ton at ovens.

STOCK QUOTATIONS

N. Y. EXCH.†	Feb. 26
Alaska Gold M.	1⅛
Alaska Juneau	2⅛
Am.Sm.& Ref.,com.	83½
Am. Sm. & Ref., pf.	106
Am. Sm. Sec., pf., A	91½
Am. Zinc	15⅝
Am. Zinc, pf.	43
Anaconda	64½
Batopilas Min	1
Bethlehem Steel	81½
Bethlehem Steel, pf.	101½
Butte & Superior	20⅛
Butte Cop. & Zinc	9⅛
Cerro de Pasco	31⅛
Chile Cop.	16⅜
Chino	43½
Colo.Fuel & Iron	39⅛
Crucible Steel	64⅛
Crucible Steel, pf.	89⅛
Dome Mines	8½
Federal M. & S.	11
Federal M. & S., pf.	33
Great Nor., ore ctf.	28⅛
Greene Cananea	40⅛
Gulf States Steel	92⅛
Homestake	81⅛
Inspiration Con	46
International Nickel	28⅛
Kennecott	33⅛
Lackawanna Steel	77⅛
Mexican Petrol	93⅛
Miami Copper	31⅛
Nat'l Lead, com.	53
National Lead, pf.	100
Nev. Consol.	18⅛
Ontario Min	5
Ray Con	24
Republic I.&S.,com.	79
Republic I. & S., pf.	98⅛
Sloss-Sheffield	50⅛
Tennessee C. & C.	17⅛
U. S. Steel, com	97⅛
U. S. Steel, pf.	110⅛
Utah Copper	83⅛
Va. Iron C. & C.	64

N. Y. CURB†	Feb. 26
Big Ledge	1.37½
Butte & N. Y.	⅜
Butte Detroit	.37½
Caledonia	.49
Calumet & Jerome	1.31½
Can. Cop. Corpn	2.06½
Carlisle	‡2
Cashboy	.10½
Con. Ariz. Sm.	2
Con. Coppermines	5.75
Con. Nev.-Utah	⅛
Emma Con	‡1
First Nat. Cop.	2
Goldfield Con.	.40⅛
Goldfield Merger	.04⅛
Greenmonster	.75
Hecla Min.	4
Howe Sound	4.62½
Jerome Verde	.75
Kerr Lake	5⅛
Louisiana	.50
Magma	38.50
Majestic	‡.28
Marsh	.05
McKinley-Dar-Sa.	.53
Milford	1.25
Mohican	‡.25
Mother Lode	.29
N. Y. & Hond.	12½
Nipissing Mines	8⅛
Nixon Nevada	1⅛
Ohio Cop.	⅛
Rawley	‡2
Ray Hercules	4⅛
Richmond	‡.56
Rochester Mines	.34
St. Joseph Lead	16⅛
Standard S. L.	.40⅛
Stewart	.25
Success	.10
Tonopah	3⅛
Tonopah Ex.	1⅛
Tribullion	.43⅛
Troy Arizona	.14
United Cop.	.50
United Verde Ext.	39⅛
United Zinc	2⅛
Utica Mines	‡.08

SAN FRAN.*	Feb. 26
Alta	‡.04
Andes	.18
Best & Belcher	.01
Caledonia	.06
Challenge Con.	‡.04
Confidence	.07
Con. Virginia	.10
Gould & Curry	.01
Hale & Norcross	.01
Jacket-Cr. Pt.	.06
Mexican	.05
Occidental	‡.60
Ophir	.11
Overman	‡.01
Savage	‡.01
Sierra Nevada	.07
Union Con.	.99
Utah Con.	‡.01
Belmont	3.15
Jim Butler	.61
MacNamara	.14
Midway	.09
Mont.-Tonopah	.10
North Star	.05
Rescue Eula	.09
West End Con.	.78
Atlanta	.11
Booth	.04
Comb. Frac.	.02
D'field Daisy	‡.02
Florence	.14
Jumbo Extension	.15
Kewanaa	.07
Nevada Hills	.05
Nevada Packard	‡.20
Round Mountain	‡.24
Silver Pick	.04
White Caps	‡.64
Big Jim	‡.75
United Eastern	‡4.50

BOSTON EXCH.*	Feb. 26
Adventure	1⅛
Ahmeek	79⅛
Algomah	.25
Alloues	51
Ariz. Com., ctfs.	13⅛
Arnold	.20
Bonanza	.20
Butte-Balaklava	.25
Calumet & Ariz.	69½
Calumet & Hecla	440
Centennial	13⅛
Copper Range	45⅞
Daly West	1⅛
Davis-Daly	5⅛
East Butte	9⅛
Franklin	5⅛
Granby	75
Hancock	.8
Hedley	11
Helvetia	.20
Indiana	.65
Isle Royale	22⅛
Kewcenaw	1⅛
Lake	6
La Salle	2⅛
Mason Valley	5⅛
Mass	6
Mayflower	1⅛
Michigan	2
Mohawk	63
New Arcadian	2
New Idria	13
North Butte	15⅛
North Lake	.30
Ojibway	75
Old Dominion	41
Osceola	59
Quincy	75
St. Mary's M. L.	53⅛
Santa Fe	.95
Seneca	8⅛
Shannon	5⅛
Shattuck-Ariz.	16
So. Lake	1⅛
So. Utah	14
Superior	4⅛
Superior & Bost.	3
Trinity	3⅛
Tuolumne	1
U. S. Smelting	46
U. S. Smelt'g, pf.	45
Utah Apex	2⅛
Utah Con.	11
Utah Metal	2
Victoria	2⅛
Winona	1⅛
Wolverine	33
Wyandot	.60

BOSTON CURB*	Feb. 25
Alaska Mines Corp.	.20
Bingham Mines	9
Boston Ely	.73
Boston & Mont.	.60
Butte & Lon'n Dev.	.13
Calaveras	1⅛
Calumet-Corbin	‡.01
Chief Con.	2⅛
Cortez	.10
Crown Reserve	.21
Crystal Cop.	.60
Eagle & Blue Bell	2
Gila Copper	‡17
Houghton Copper	.75
Intermountain	‡.70
Iron Cap, Com.	19
Mexican Metals	.44
Mines of America	1⅛
Mojave Tungsten	.04
Nat. Zinc & Lead	.30
Nevada-Douglas	.98
New Baltic	.99
New Cornelia	16⅛
Oneco	.20
Pacific Mines	‡.35
Rex Cons.	.12
Yukon Gold	1⅛

SALT LAKE*	Feb. 26
Bannack	‡.26
Cardiff	2.50
Colorado Mining	.08
Daly	1.45
Daly-Judge	6.00
Empire Copper	‡1.10
Gold Chain	.08
Grand Central	.55
Iron Blossom	.46
Lower Mammoth	‡.03
May Day	.02
Moscow	‡.02
Prince Con.	.53
Rico Wellington	.17
Silver-King Coal'n	2.65
Silver King Con.	2.67
Sioux Con.	.02
So. Hecla	.72
Tintic Standard	‡1.35
Uncle Sam	‡.01
Walker Cop.	1.75
Wilbert	.09
Yankee	.05

TORONTO*	Feb. 26
Adanac	.09
Bailey	‡.05
Beaver Con.	.24
Chambers Ferland	.10
Coniagas	3.15
Hargraves	.06
La Rose	.32
Peterson Lake	.08
Temiskaming	.27
Wettlaufer-Lor.	.04
Davidson	.34
Dome Exten.	.10
Dome Lake	.28
Hollinger	4.87
McIntyre	1.40
Newray	.23
Porcu. Crown	.18
Teck-Hughes	.50
Vipond	.22
West Dome	.11

STOCK QUOTATIONS—Continued

COLO. SPRINGS	Feb. 26
Cresson Con.	5.00
Doctor Jack Pot	.03
Elkton Con.	.05½
El Paso	.15
Gold Sovereign	.02½
Golden Cycle	1.76
Granite	.40
Isabella	.07
Mary McKinney	.06½
Portland	1.10
United Gold M.	.15
Vindicator	.35

LONDON	Jan. 41		
Alaska G. F.	£0	10s	6d
Burma Corp.	4	3	9
Cam & Motor	0	14	0
Camp Bird	0	8	0
El Oro	0	9	3
Esperanza	0	9	0
Mexican Mines	5	12	6
Min. Corp. Can.	0	15	9
Nechi, pfd.	0	9	9
Oroville	0	18	6
Santa Gert'dis.	0	13	9
Tomboy	0	19	9

* Bid prices. † Closing prices. ‡ Quotations.

MONTHLY AVERAGE PRICES OF METALS

Silver	New York			London		
	1916	1917	1918	1916	1917	1918
Jan.	56.775	75.630	88.702	26.960	36.682	44.356
Feb.	56.755	77.585		26.975	37.742	
Mar.	57.935	73.861		27.597	36.410	
April	64.415	73.875		30.662	36.963	
May	74.269	74.745		35.477	37.940	
June	65.024	76.971		31.060	39.065	
July	62.940	79.010		30.000	40.110	
Aug.	66.083	85.407		31.498	43.418	
Sept.	68.515	100.740		32.584	50.920	
Oct.	67.855	87.332		32.361	44.324	
Nov.	71.604	85.891		34.192	43.584	
Dec.	75.765	85.960		36.410	43.052	
Year	65.661	81.417		31.315	40.851	

New York quotations cents per ounce troy, fine silver; London, pence per ounce, sterling silver, 0.925 fine.

Copper	New York		London			
	Electrolytic		Standard		Electrolytic	
	1917	1918	1917	1918	1917	1918
Jan.	28.673	23.500	131.921	110.000	142.895	125.000
Feb.	31.750		137.895		148.100	
Mar.	31.481		136.750		151.000	
April	27.935		133.842		147.158	
May	28.788		130.000		142.000	
June	29.962		130.000		142.000	
July	26.620		128.409		140.409	
Aug.	25.380		122.391		137.000	
Sept.	25.073		117.500		135.250	
Oct.	23.500		110.000		125.000	
Nov.	23.500		110.000		125.000	
Dec.	23.500		110.000		125.000	
Year	27.180		124.892		138.401	

Tin	New York		London	
	1917	1918	1917	1918
January	44.175	(a)	185.813	293.227
February	51.420		198.974	
March	54.388		207.443	
April	55.910		220.171	
May	63.173		245.114	
June	62.053		242.083	
July	62.570		242.181	
August	62.681		243.979	
September	61.542		244.038	
October	61.851		247.467	
November	74.740		274.943	
December	87.120		298.556	
Av. year	61.802		237.563	

(a) No average computed.

Lead	New York		St. Louis		London	
	1917	1918	1917	1918	1917	1918
January	7.626	6.782	7.530	6.684	30.500	29.50
February	8.636		8.595		30.500	
March	9.199		9.120		30.500	
April	9.288		9.158		30.500	
May	10.207		10.202		30.500	
June	11.171		11.123		30.500	
July	10.710		10.644		30.500	
August	10.594		10.518		30.500	
September	8.680		8.611		30.500	
October	6.710		6.650		30.500	
November	6.249		6.187		30.500	
December	6.375		6.312		30.500	
Year	8.787		8.721		30.500	

Spelter	New York		St. Louis		London	
	1917	1918	1917	1918	1917	1918
January	9.619	7.836	9.449	7.661	48.329	54.000
February	10.045		9.875		47.000	
March	10.300		10.130		47.000	
April	9.459		9.289		54.632	
May	9.362		9.192		54.000	
June	9.371		9.201		54.000	
July	8.643		8.473		54.000	
August	8.360		8.190		54.000	
September	8.136		7.966		54.000	
October	7.983		7.813		54.000	
November	7.847		7.672		54.000	
December	7.685		7.510		54.000	
Year	8.901		8.813		52.413	

New York and St. Louis quotations, cents per pound. London, pounds sterling per long ton.

Pig Iron, Pgh.	Bessemer‡		Basic‡		No. 2 Foundry	
	1917	1918	1917	1918	1917	1918
January	$35.95	$37.25	$30.95	$33.95	$30.95	$33.95
February	36.37		30.95		30.95	
March	37.37		33.49		35.91	
April	42.23		38.90		40.06	
May	46.94		42.84		43.60	
June	54.22		50.05		50.14	
July	57.45		53.80		53.95	
August	54.17		50.37		53.95	
September	46.40		42.24		48.58	
October	37.25		33.95		33.95	
November	37.25		33.95		33.95	
December	37.25		33.95		33.95	
Year	$43.57		$39.62		$40.83	

‡ As reported by W. P. Snyder & Co.